CRANFIELD UNIVERSITY

An Approach for Innovation Outsourcing

Shahwar Rehman

School of Applied Sciences

Doctor of Philosophy

CRANFIELD UNIVERSITY

School of Applied Sciences

PhD Thesis

Academic Year 2012-2013

Shahwar Rehman

An Approach for Innovation Outsourcing

Supervisor: Prof. Ashutosh Tiwari

January 2013

This thesis is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

To my father

Acknowledgements

This study would not have been possible without the aid and support of many people, not all of which are mentioned below, but to whom I express my sincere gratitude.

I express my deepest gratitude to Prof. Ashutosh Tiwari, my supervisor, for his expert direction and endless personal support. I would also like to thank Dr. Peter Ball for his useful advice.

My appreciation goes out to all those who generously gave of their valuable time and wealth of knowledge during interviews to aid this research.

Finally, I would like to pay special thanks to my father, a personal and professional educator, to whom I owe much.

Abstract

This study concerns facilitating organisational capability for outsourcing innovation, enabling firms to take advantage of its many benefits, (e.g., reduced costs, increased flexibility, access to better expertise and increased business focus), whilst mitigating its risks.

Its purpose is to develop a generic holistic model to aid firms successfully outsource innovation.

The model is developed in two stages using a qualitative theory-building research design. The initial stage develops a preliminary model which is subsequently validated and refined during the second stage.

Guided by the research aim, template analysis is used to inductively form an innovation outsourcing template from a literature data set assessed for its suitability. The template is interpreted as an innovation outsourcing archetype to produce a framework. This is explored, with the aid of influence diagrams, to make explicit the associations between innovation outsourcing capabilities, process and performance. The outcome is a set of propositions which constitute a preliminary innovation outsourcing model.

The propositions which form the preliminary model are deductively explored to identify whether they also exist in a different data set. A methodically designed semi-structured interview survey is executed with the aid of a rich picture survey instrument to gather data for this purpose. The data is analysed through pattern matching and explanation building to explore the correlations which constitute the model. Where they correlate as predicted, propositions are confirmed.

Where they do not, an explanation is sought and tested. The outcome is a validated innovation outsourcing model.

The contribution to knowledge is an innovation outsourcing model which aids the realisation of performance. The model achieves this through a three-stage process which enables the alignment of capability to outsourced innovation activity, and makes actual performance outcomes, rather than expected benefits, the focus of innovation outsourcing aims.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

This chapter introduces the domain of innovation outsourcing. Its selection as an area of study is justified through the development of a narrative which displays its significance to the firm. Background to the domain is provided to contextualise the study prior to an overview of the study's research aims, objectives, approach and research contribution. The chapter concludes with an overview of the structure of this thesis.

1.1 A cautionary tale

Google takes a bite out of Apple – Eric Schmidt, chief executive officer of Google, was elected to Apple's board of directors in August 2006. The appointment marked the beginning of Apple's innovation outsourcing relationship with Google. Welcoming his appointment, Apple's chief executive officer, Steve Jobs said *"Like Apple, Google is very focused on innovation and we think Eric's insights and experience will be very valuable in helping to guide Apple in the years ahead"* (Apple, 2006).

Apple had big ambitions; it was seeking to reinvent the mobile phone market. A significant aspect of Google's involvement in the relationship was the development of a new Apple smartphone. Google was tasked with developing a suite of mobile web tools and applications for the iPhone to provide users with easy and universal access to facilities such as e-mail, calendars, news and maps.

The iPhone was unveiled to great success in January 2007 at Macworld in San Francisco (Apple, 2007).

It was a year after Eric Schmidt had joined Apple's board when his mobile phone rang as he was driving along the highway in the Nevada desert. It was Steve Jobs. He was angry. The call dropped due to the poor signal in the desert. Eric located a convenience store and called Jobs back using a payphone. Jobs was incandescent with rage. He let loose a tirade against Eric Schmidt and Google. The reason for Jobs' anger was the discovery that Google was developing a rival smartphone operating system, Android (Gawker, 2010).

Eric Schmidt resigned from the Apple board in August 2009. Conflicts of interest were cited as the reason in an Apple press release, *"Unfortunately, as Google enters more of Apple's core businesses, with Android and now Chrome OS, Eric's effectiveness as an Apple Board member will be significantly diminished, since he will have to recuse himself from even larger portions of our meetings due to potential conflicts of interest"* (Apple, 2009).

The parting has seen the conflict between Apple and Google continue; in the market place, in the social media (Fig. 1.1) (Allaboutandroid, 2012), and the courts. Jobs describes the contents of a lawsuit filed by Apple against Google,

Figure 1.1: A parody of Google's Android handsets versus Apple's iPhone.

"Google you [expletive removed] ripped off the iPhone, wholesale ripped us off. Grand theft. I will spend my last dying breath if I need to, and I will spend every penny of Apple's $40 billion in the bank, to right this wrong. I'm going to destroy Android, because it's a stolen product. I'm willing to go thermonuclear war on this" (Isaacson, 2011).

Whilst the extent of Steve Jobs' anger at Eric Schmidt, Google and its founders is understandable, perhaps some of that anger should have been directed at himself and Apple's management. Undoubtedly, this was an enormous failure by Apple and its management for outsourcing innovation. Apple's lawsuit against Google was, to use a metaphor, locking the stable door after the horse had bolted. Prior to engaging in its relationship with Google, it would have been prudent of Apple to ask itself the key question, 'what structures and procedures do we need to put in place to ensure that we achieve our objectives without jeopardising the business'?

1.2 This study

The above narrative analysis, (i.e., accounts relating to episodes and their interconnections (Bryman and Bell, 2011)), illustrates the essence of this study. The challenge is for firms to develop capabilities for managing innovation outsourcing, taking advantages of its many benefits, (e.g., reduced costs, increased flexibility, access to better expertise and increased business focus), whilst mitigating its risks. This study concerns facilitating organisational capability for managing the outsourcing of innovation.

1.2.1 Clarification of terms

To avoid any misinterpretation, use of the term 'innovation outsourcing' is clarified at the outset. The term is used to refer to the outsourcing by an organisation of its innovation activity, i.e., outsourcing *of* innovation. The terms 'innovation outsourcing' and 'outsourcing of innovation' are used interchangeably. The term does not refer to new paradigms, products or processes concerning the sourcing of goods and services previously produced inside the boundary of an organisation, i.e., innovation *within* outsourcing.

Relationship with open innovation Use of the term 'innovation outsourcing' within this study encompasses the paradigm of open innovation which emphasises the potential of external resources to create value and promotes the building of

firm capability to take advantage of its benefits (Chesbrough, 2003). Whereas open innovation is no more than a paradigm, *'... is not ipso facto a recipe for outsourcing R&D'* (Chesbrough and Crowther, 2006), the term 'innovation outsourcing' is used to extend the paradigm to the process of its realisation, encompassing its determinants, selection, implementation and outcomes.

Adopted view The view adopted by this study is that innovation outsourcing is a strategic decision involving the antecedents, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries.

1.2.2 Context

Accounts like that of Apple above are not isolated, neither are they confined to a particular industry sector, geographical region, nor size of firm. For example, between 1990 and 2002, the motor manufacturer Fiat outsourced a large proportion of the research and development of its product design and engineering to numerous suppliers (Ciravegna and Maielli, 2011). The result of this highly outsourced R&D strategy was an erosion of Fiat's capabilities, poor products and rapidly declining sales. So, how is it that firms with the resources of Apple and Fiat can make decisions which potentially put the organisation at risk?

Traditional view of innovation Identifying, developing and bringing new products to market are a business imperative for many organisations. Innovation can be described as anything new about what a company produces or how it operates (Hill and Jones, 2001) (Tidd et al., 2005). It is, arguably, the most important component of long run business advantage and the reason why developing a strategic capability for innovation is viewed by many organisations as essential to their long-term survival.

The traditional perception of innovation by organisations is that of a central value-creating capability, i.e. core competency. It has led many firms to ensure that their R&D, (research and development), functions are well resourced and retained within the bounds of the organisation. The structures and routines for

managing innovation undertaken within firms have been developed over many years and are, consequently, well-defined and integrated into the firm.

Outsourcing and innovation The concept of outsourcing (i.e., the sourcing of goods and services previously produced internally within the sourcing organisation from external suppliers (McIvor, 2005)), has found favour with many firms as a management tool for value creation. Its use has been exploited by several firms in various business functions, (e.g., manufacturing production, information systems and facilities management).

The ever-increasing complexity and cost of innovation efforts is driving many firms to seek increased effectiveness and efficiency of their R&D functions. A solution considered by some firms is to apply the practice of outsourcing to their innovation functions. This is being encouraged by a combination of various macro factors, including: the growth in the number of specialist markets worldwide; growth in the global availability of knowledge workers and knowledge bases; growth in global interaction capabilities supported by enhanced information technologies, and; relaxation of many economic and political barriers worldwide (Quinn, 2000).

Innovation as an activity wholly undertaken within the firm is steadily being eroded with the growing evidence that it is increasingly being outsourced.

Innovation outsourcing Firms are outsourcing innovation within the UK (Robson and Haigh, 2008) (Drayson, 2008) (Department for Innovation, Universities & Skills, 2008), internationally (Baumann and Grupp, 2008) (Li et al., 2008), and across industries. Firms from as diverse sectors as technology, pharmaceuticals and consumer goods are seeking to source a significant proportion of their new ideas from outside the firm (Ganotakis and Love, 2012) (Calantone and Stanko, 2007). For example, Pharmaceutical firms such as GlaxoSmithKline are outsourcing much of their new therapeutic research and Proctor & Gamble aim to source fifty percent of their new product ideas from outside the company.

In the rush to outsource innovation firms may be disregarding the complexities associated with the notion of innovation outsourcing. For example, innovation outsourcing is uniquely characterised by the issue of the 'unknown', i.e., it is difficult to ascertain, a priori, innovation outsourcing outcomes. It is possible

that firm's may be 'blindly' adopting traditional outsourcing practices applied to existing innovation practices with sub-optimal consequences.

1.2.3 Elevator pitch

Research should be easily communicable and to as wide an audience as possible. This includes not only those who have a specific interest in the work, and those who may have a passing interest, but also those who may develop a future interest. A senior academic, a distinguished professor of international standing and well-respected in his field, advised during a review that research should be able to be communicated in layman's terms within a paragraph or the few minutes that you are able to hold someone's attention. Typically, this is termed an elevator pitch, reflecting the notion that it should be able to summarise the exciting and unique aspects of the work in the time it takes for a typical, (i.e., up to two minutes), elevator ride. This study's elevator pitch is:

This study's outcome helps firms realise their potential for lower innovation costs and increased innovation profits without jeopardising the business. Innovation can be safely and successfully outsourced if the innovation activity is matched to the firm's outsourcing capability. This is achieved by aligning appropriate outsourcing management resources to the type of innovation activity outsourced.

The rest of this thesis document details how the above understanding is reached.

1.3 Programme of research

An overview of this study's programme of research is displayed in Fig. 1.2. The primary research question of how firms should successfully outsource innovation is addressed by the study's aim which is to develop a generic holistic model to aid firms to successfully outsource innovation. Adopting a qualitative research approach, the aim is fulfilled through an inductive/deductive process of descriptive theory-building using an initial data set of innovation outsourcing literature.

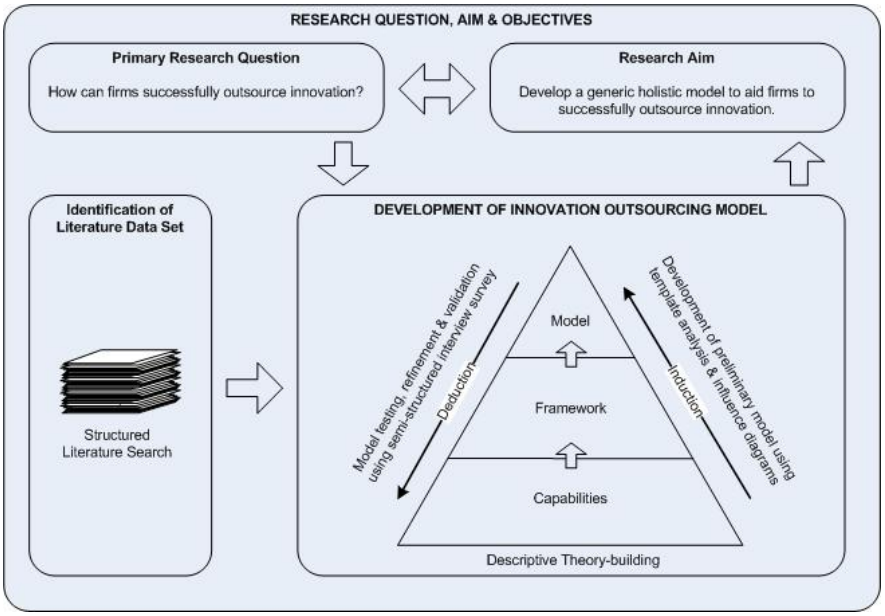


Figure 1.2: Research programme overview

1.3.1 Research question, aim & objectives

An overview of this study's research question, aim and objectives is summarised in Fig. 1.3.

Firms outsource innovation, ultimately, to improve firm performance, either through reducing the cost of innovation activity or by increasing potential revenue. They must be able to achieve their expected outcomes through effective structures and routines without jeopardising the business. This is summarised as the following primary research question:

Research question: How can firms successfully outsource innovation?

A review of the extant literature in relation to the above research question identifies that much of the innovation outsourcing research has a narrow focus concentrating on a few individual elements of the phenomenon. There does not exist a study which addresses innovation outsourcing in its entirety as a firm-centric practice applicable across industries. This leads to this study's research

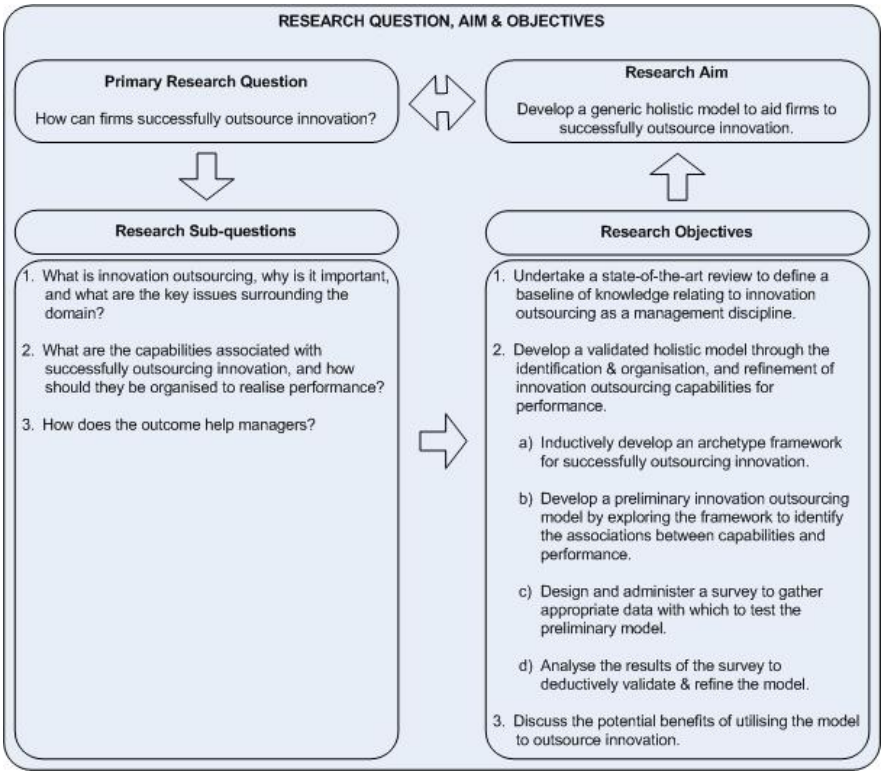


Figure 1.3: Overview of research question, aim and objectives

aim which is to:

Research aim: *Develop a generic holistic model to aid firms to successfully outsource innovation.*

Research sub-questions: Consideration of the research aim enables the primary research question to be decomposed in to its three constituent research sub-questions:

1. What is innovation outsourcing, why is it important, and what are the key issues surrounding the domain?

2. What are the capabilities associated with successfully outsourcing innovation, and how should they be organised to realise performance?

3. How does the outcome help managers?

Research objectives: The three research sub-questions are addressed by the following research objectives to fulfil the research aim and, consequently, the primary research question:

1. Undertake a state-of-the-art review to define a baseline of knowledge relating to innovation outsourcing as a management discipline.
2. Develop a validated holistic model through the identification & organisation, and refinement of innovation outsourcing capabilities for performance.
   (a) Inductively develop an archetype framework for successfully outsourcing innovation.
   (b) Develop a preliminary innovation outsourcing model by exploring the framework to identify the associations between capabilities and performance.
   (c) Design and administer a survey to gather appropriate data with which to test the preliminary model.
   (d) Analyse the results of the survey to deductively validate & refine the model.
3. Discuss the potential benefits of utilising the model to outsource innovation.

1.3.2 Methodology overview

Innovation outsourcing is a relatively new concept which has attracted a great deal of diverse attention over a short period of time. Due to its relative novelty with an existing but limited body of knowledge this study's aim and objectives lend themselves to the following research design:

Research design: Qualitative theory-building.

As a qualitative study, particular attention is paid to considerations of research quality. The term 'trustworthiness' (Lincoln and Guba, 1985) is adopted as a measure for a good qualitative study to counter the criticism that the terms 'reliability' and 'validity' are inherently quantitative terms. Consideration is provided throughout to concerns of research credibility, transferability, dependability, and confirmability by describing and documenting the research process in as much detail as possible.

This study's research objectives are fulfilled through a phase of descriptive theory-building (Christensen, 2006).

1.3.2.1 Development of innovation outsourcing model

Development of an innovation outsourcing model to realise firm performance is achieved by fulfilling the following two stages:

1. Development of preliminary model – Inductive development of a preliminary model for outsourcing innovation using an appropriate and justifiable data set.

2. Validation of model – Deductive testing & refinement of the model using a different data set to that used for developing the preliminary model. The model is refined through a continuous process of identifying and resolving anomalies between the two data sets.

This is summarised in Fig. 1.4.

Development of preliminary model A data set of innovation outsourcing literature is selected as the basis from which to develop a preliminary innovation outsourcing model. The data set is identified from two leading databases within the business and management domains using a structured methodological approach. Its use is justified based on its overall and specific suitability (Saunders et al., 2009).

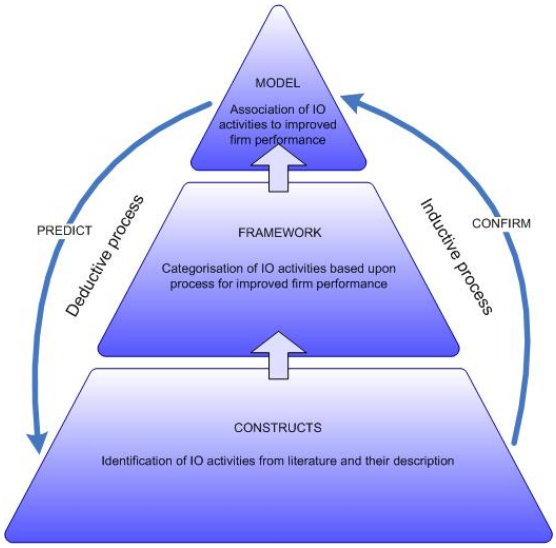


Figure 1.4: Building descriptive innovation outsourcing theory

Guided by the study's research aim and objectives, template analysis is used to inductively produce an account of the data set. Weft, (computer-assisted qualitative data analysis software), is employed to aid the administrative aspects of coding and template development. Iterations of analysis are undertaken to produce a template which is used to inform an archetype of innovation outsourcing, (i.e., framework). The framework is explored with the aid of influence diagrams to make explicit the associations between innovation outsourcing capabilities, process and firm performance. The outcome is a preliminary model of innovation outsourcing.

Validation of model The model is tested and refined by exploring whether the correlations between innovation outsourcing activities & process and firm performance also exist in a different data set. Where they correlate as predicted, the theory is confirmed. Where they do not, an explanation is sought and subsequently tested.

The data set used to validate the model is collected using a semi-structured interview survey. A methodical approach is adopted for the survey's design and

execution to aid research quality (Kvale and Brinkmann, 2009). In particular, an interview survey instrument is developed comprising rich pictures to overcome the challenge of eliciting and capturing as much detailed and nuanced information as possible during interviews. The interview data is analysed using pattern matching and explanation building to explore the correlations between innovation outsourcing activities & process and firm performance. The outcome is a validated innovation outsourcing model correlating to firm performance.

1.4 Research contribution

This study presents a holistic understanding for managing innovation outsourcing in terms of its process and capabilities. It displays that innovation outsourcing is best understood from a systems and contingency perspective because it is a complex multi-faceted concept comprising various characteristics encompassing several theoretical foundations. Key aspects of the holistic innovation outsourcing process are summarised below.

Performance: Effective innovation outsourcing requires performance, rather than expected benefits, to be made the focus of its aims. Performance is central to understanding innovation outsourcing because it is ultimately the rationale for doing so. Consequently, all management decisions and actions associated with innovation outsourcing should be related to performance. Performance can be described in terms of the value concept. It is achieved by ensuring that the utility of outsourced innovation activity outweighs the total costs of achieving the delivered benefits. Utility refers to the perceived benefits of the innovation activity, whilst costs relate to the capabilities necessary for delivering the benefits.

Capabilities and performance: Successful innovation outsourcing requires a sufficient and broad range of capabilities due to the significant intrinsic risks it poses. Capabilities concern the infrastructure, skills, routines and procedures for undertaking the tasks of what, why, where, to whom, and how of innovation outsourcing. They include, for example: differentiating core and non-core activity,

location choice, provider selection, managing product/service modularity, managing infrastructure flexibility, managing culture, managing knowledge, managing learning, etc.

A three stage process: Managing innovation outsourcing involves the building of capability whilst ensuring performance. This is achieved through a three-stage process that is bounded by its environment. The three stages involve: 'selection' - determining innovation activity that can potentially be outsourced; 'deployment' - determining innovation activity that can actually be outsourced, and; 'implementation' - managing outsourced innovation activity. The process provides robust governance for outsourcing which is explained in terms of an integrated view of four strategic management perspectives: industry view (iv), transaction cost economics (tce), resource based view (rbv), and relational view (rv).

External constraints and performance: Performance requires that a firm's decision to outsource innovation activity be made within the context of its industry. This is explained by the industry view (iv), where performance through innovation outsourcing can potentially be constrained by a firm's external influences, (e.g., globalisation, uncertainty, etc.)

Alignment of innovation activity to rationale for outsourcing: Performance requires all innovation activity that is potentially outsourced to display a clear rationale for doing so. This is achieved by the selection stage which entails determining what innovation *should be* outsourced and why it *should be* outsourced. Determining what innovation *should be* outsourced involves differentiating innovation activity based on its association with core competencies (rbv). Innovation activity associated with core competencies must be retained, whilst the remaining innovation activity may be considered for outsourcing. Determining why innovation *should be* outsourced entails ascertaining the utility of innovation in terms of its nature, (i.e., minimising cost, or maximising profit), and scale. Selection may be initiated either by identifying what innovation *should be* outsourced and attributing a rationale, or it may be initiated by identifying a

rationale and then identifying appropriate innovation activity that fits the rationale. Regardless of how selection is initiated, the ability to assess performance requires each and every innovation activity selected for potential outsourcing to have a clear rationale and vice versa.

Effective routines and performance: Performance requires effective routines for determining where, to whom, and how innovation is outsourced. This role is fulfilled by the deployment stage. Determining where innovation is outsourced involves making location choices for outsourced innovation. Determining to whom innovation is outsourced involves selecting an appropriate provider. Determining how innovation is outsourced involves ensuring appropriate infrastructure, routines and culture for outsourcing innovation. The basis for effective routines is the resource based view (rbv), which explains that a lack of sufficiently effective routines may result in sub-optimal choices which can impact performance.

Alignment of capability to innovation activity: The deployment stage also performs the pivotal role of determining the innovation activity that *is to be* outsourced. This is achieved by gauging the alignment of innovation outsourcing capability to the innovation activity that should be outsourced. The deployment stage is able to perform this key function due to its position between the selection and implementation stages where it is able to consider all appropriate capabilities and influences prior to any decision to outsource. Explained through the integration of (tce) (iv) (rbv) (rv), the robust governance conferred by the deployment stage to the innovation outsourcing process is due its ability to consider and balance all key factors prior to outsourcing innovation.

If capability is aligned to the innovation activity, it can be outsourced successfully. If not, a decision is required on whether to invest in resources to address any shortfall in capability. The decision to invest is dependent on the utility of innovation activity outweighing the total costs of outsourcing, including those for building additional capability. Performance requires careful gauging of innovation outsourcing capability for appropriate resourcing decisions to be made, as

both under-investment and over-investment in capabilities may negatively impact performance.

Alignment of capability and sustained performance: The pivotal role of the deployment stage enables the continual identification, resourcing and building of capabilities aligned to the innovation activity being outsourced. Explained by the resource based view (rbv), this provides a mechanism for sustained innovation outsourcing performance whereby the continual focus on performance and capabilities enables the dynamic building of organisational, functional and technological skills which are adaptive and difficult to imitate.

Day-to-day management and performance: Performance requires sufficient capability for the day-to-day management of outsourced innovation activity. Day-to-day management is fulfilled by the implementation stage of the process which includes capability for: managing through projects, managing knowledge, and managing learning. The significance of the implementation stage is explained in terms of the relational view (rv), as the ability to create value through cultivating relationships between the firm and the organisations to which it outsources innovation.

1.5 Outline of thesis

This thesis comprises eight chapters. A summary of each of the seven following chapters is provided below.

Ch 2. Review of literature: Reviews and analyses the extant innovation outsourcing literature to define a baseline of existing knowledge and identify knowledge gaps to guide further research. A three stage methodological approach is synthesised and used to determine: the characteristics of innovation outsourcing; its significance, and; key areas of existing and potential research relating to innovation outsourcing.

Ch 3. Research methodology & design: Provides an overview of the research issue, from which are derived the primary research question, aim and objectives. A valid, reliable and robust research design and methodology is formulated to fulfil the research aim by the systematic consideration of all the options available. A qualitative research design is formulated to build innovation outsourcing theory relating to the primary research question of how firms can successfully outsource innovation.

Ch 4. Framework development: Develops an innovation outsourcing framework. The development comprises part of the initial stage of a two stage process for building descriptive innovation outsourcing theory. Template analysis is employed to inductively develop an innovation outsourcing template from a data set of innovation outsourcing literature, the use of which is previously justified. The template is used to inform the framework as an innovation outsourcing archetype.

Ch 5. Model development and visualisation: Develops a preliminary innovation outsourcing model. The development completes the initial stage of a two stage process for building descriptive innovation outsourcing theory. The association between innovation outsourcing capabilities, their organisation and performance is explored with the aid of influence diagrams. Statements of association are made explicit to formulate the model. Rich pictures are developed of the preliminary model which are to be used as part of an organised process of enquiry and learning.

Ch 6. Survey design & administration: Systematically develops and administers a semi-structured interview survey protocol to gather primary research data with which to validate and refine the preliminary holistic innovation outsourcing model. The protocol includes the development of an interview survey instrument as well as the identification of procedures for analysing the data collected.

Ch 7. Model validation, refinement & discussion: Deductively validates and refines the preliminary innovation outsourcing model by identifying whether the associations between innovation outsourcing capabilities, their organisation and performance which comprise the model also exist in the interview survey data set. This forms the second stage of a two stage process for building descriptive innovation outsourcing theory.

The interview survey data is analysed using pattern matching and explanation building analysis techniques. Where the associations exist in the interview survey data the model is confirmed. Where the model is not confirmed, explanations are sought through iterations of model development and testing to refine the model. The outcome is a validated model of innovation outsourcing.

Findings concerning the overall innovation outsourcing process and its associated capabilities are summarised and discussed.

Ch 8. Conclusions: Pulls together and discusses the principal findings in relation to the research programme's aim and objectives. The potential benefits of utilising the model to outsource innovation are identified and discussed. Limitations of research and suggestions for future work are identified.

1.6 Summary

This chapter has provided background and context to this study. The domain of innovation outsourcing has been introduced and the rationale for its selection as an area of study has been justified by illustrating its significance to the firm. An overview of this study's research programme has been provided prior to an overview of the structure of the thesis.

Chapter 2

Review of Literature

This chapter reviews the extant literature relevant to innovation outsourcing. Key themes of research are explored and gaps in knowledge highlighted. An overview of the chapter is illustrated in Fig. 2.1.

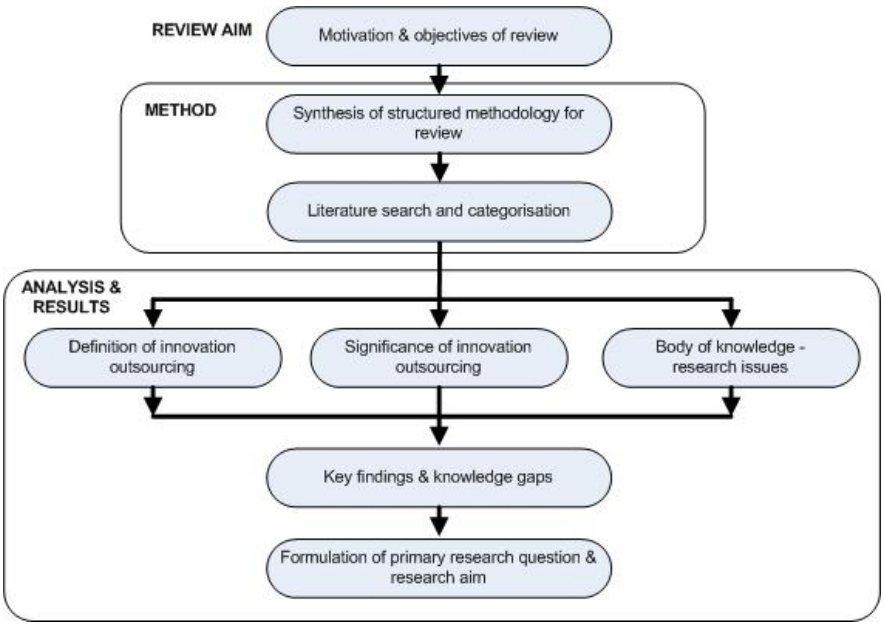


Figure 2.1: Overview of review of literature

2.1 Motivation & objectives of review

Innovation outsourcing is a phenomenon that is gaining increasing interest amongst both practitioners and academics alike. Despite this there does not exist a comprehensive study which identifies the status of knowledge within this domain. This study aims to fill this gap. The extant literature is reviewed and analysed to define a baseline of existing research and to guide further research. Specifically, the objectives of this review are to determine:

1. What is innovation outsourcing? - (i.e., what factors define innovation and what theories underpin those factors?)

2. What is the significance of innovation outsourcing? - (i.e., why is innovation outsourcing important and to whom is it important?)

3. What are the key issues associated with innovation outsourcing - (i.e., what are the current areas of research associated with innovation outsourcing?)

To address the above objectives a framework for analysing the literature is synthesised from existing frameworks for analysing outsourcing literature. The focus of analysis is on identifying prominent sources of studies within this domain, research aims, research approach, reference theories and scope.

2.2 Synthesis of methodology framework

Due to the novelty of the domain, there does not exist a comprehensive review of innovation outsourcing literature. Consequently, neither does there exist a means for conducting such a review. The initial task, therefore, is to synthesise a methodology for conducting a comprehensive and systematic review of innovation outsourcing literature to fulfil the objectives identified above. The emphasis on conducting a *systematic* review is to aid the study's 'trustworthiness' (Lincoln and Guba, 1985), i.e., research quality.

2.2.1 Systematic reviews

Conducting systematic reviews has its roots in medical science (Cook et al., 1997) (Wolf et al., 2001) where methods have been developed to address the criticism that ad hoc mechanisms for collecting and interpreting secondary data leads to inappropriate interpretations and recommendations. Undertaking systematic reviews of literature differ from traditional reviews due to their formal planning and execution which leads to transparent, reproducible, and consequently better quality research outcomes.

During the past decade, the above perceived advantages has led to the migration of systematic reviews from the medical science discipline to management science. A framework comprising the stages and phases for conducting a systematic review is analysed by (Tranfield et al., 2003) to highlight the differences between conducting reviews within the medical science and management domains. A key understanding derived from the study by (Tranfield et al., 2003) is that reviews are required to be practitioner and context sensitive with both methodological rigour and practical relevance if they are to lie at the heart of pragmatic management research.

Management science is a broad discipline, consequently, use of a framework for conducting a systematic review with a management science context may be too generic. To aid the credibility (i.e., internal validity) and transferability (i.e., external validity) of the study, domains closer in context to the area of interest, (i.e., outsourcing), are explored to synthesise a framework for conducting a systematic review.

2.2.2 Studies from related domains

To inform the synthesis of a systematic methodology, an initial search is undertaken to identify studies within related domains that have employed systematic methodologies for conducting a comprehensive review of literature.

Journal papers whose titles match the boolean search term *'outsourcing AND literature'* are identified from two leading databases of literature within the business and management domains, 'EBSCOHost Business Source Complete' and 'Proquest ABI/Inform Complete'. The search returned a total of 33 papers, 19

papers from EBSCOHost and 14 papers from Proquest. These were filtered to remove duplicates, conference papers, book reviews, and studies that simply did not relate to reviews of literature within outsourcing domains. This resulted in 16 papers whose studies of literature span 5 domains: IS/IT, (information technology/information systems), outsourcing, outsourcing; offshore outsourcing; general outsourcing; HR, (human resources), outsourcing; logistics outsourcing, and; library services outsourcing. Each of the papers was read carefully. This identified 9 studies that adopted a systematic methodological approach to conducting their review of literature. These are summarised in table 2.1. The 9

Literature Survey Outsourcing Domain	Papers Adopting a Systematic Methodology
IS/IT Outsourcing	(Khan et. al., 2011a) (Khan et. al., 2011b) (Gantman, 2011) (Lacity et. al., 2010) (Gonzalez et. al., 2006) (Dibbern et. al., 2004)
Offshore Outsourcing	(Mohiuddin, 2011) (Oliveira et. al., 2010)
General Outsourcing	(Bin & Qureshi, 2006)

Table 2.1: Outsourcing studies conducting a systematic review of literature

papers span three domains, IS/IT outsourcing, offshore outsourcing and general outsourcing. Two of the domains, IS/IT outsourcing and general outsourcing, are relatively mature whose earliest papers are from 2004 and 2006 respectively.

2.2.3 Methodology framework

The objectives and approach used within the 9 papers were studied in detail and are summarised below:

Objectives The objectives of outsourcing reviews of literature vary in their scope. Some papers state specific and narrow objectives, (Khan et al., 2011a)

(Khan et al., 2011b) (Mohiuddin, 2011) (Jiang and Qureshi, 2006), whilst others have a broader agenda of developing a comprehensive picture of the domain (Gantman, 2011) (Oliveira et al., 2010) (Lacity et al., 2010) (Gonzalez et al., 2006) (Dibbern et al., 2004). All 9 papers aim to identify future areas of research.

Specific objectives tend to be associated with elements of the outsourcing process, e.g, (Khan et al., 2011a) seeks to identify factors that have a negative impact on vendor selection. Studies with broader objectives tend to build models of the overall outsourcing process, e.g., (Lacity et al., 2010) develop models of IT outsourcing decisions and outcomes.

Approach Whilst there are differences in the level of detail with which studies describe their methods, in general, they involve the following elements which are aligned to each study's individual objectives:

- Search strategy - involves identifying the literature databases to be used and developing appropriate search terms. The use of specific literature databases are justified based on the domain and their coverage of the domain. Search terms are constructed by aligning them to the study's objectives by identifying the 'intervention', 'population', and 'outcomes of relevance' (Khan et al., 2011a) (Khan et al., 2011b). Alternative spellings and synonyms of search terms, and boolean operators for use within search strings are identified. Key words within papers that are returned are reviewed to verify and refine search strings.

- Selection strategy - involves the selection and verification of papers comprising the review. Inclusion and exclusion criteria for papers within the review are explicitly stated. Reviewer bias within the selection procedure is mitigated, typically, by involving a secondary reviewer to confirm that a random sample of selected papers meet the selection criteria specified.

- Analysis strategy - involves specifying the data extraction, categorisation and analysis procedures that are applied to each paper in the final selection list. These are aligned to the objectives of individual reviews. In general, the analysis undertaken by papers includes: identifying the distribution of papers by year, author, publication and geography; research

methods adopted; theoretical underpinnings; main themes, and; elements of the outsourcing process.

The above framework for conducting a systematic review of literature, summarised in Fig. 2.2, is used to inform the methodology used for reviewing the extant literature relating to innovation outsourcing.

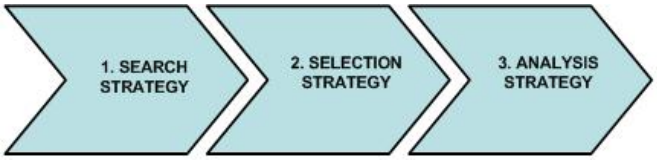


Figure 2.2: Framework for conducting a systematic review of literature

2.3 Methodology

A structured three stage methodological approach, derived from the framework synthesised above, is adopted for the review: data search, data selection, and data analysis. The rationale and methods used to collect relevant data, categorise and analyse the literature are described. The outcome of the analysis of innovation outsourcing literature is presented later in this chapter.

2.3.1 Data search

The data search stage forms the basis of any review of literature. It is important, therefore, to ensure that the decisions which form the foundation of a review are appropriately justified.

Management databases Innovation outsourcing is treated as a discipline used by management to make informed decisions based on a good understanding of the enterprise and its external environment. It includes aspects such as innovation outsourcing's theoretical influences and the process for its evaluation and management, i.e., determining the scope of an organisation's activities, the importance of those activities to the organisation, the capability of an organisation

relative to its competitors, establishing, developing, managing and monitoring outsourcing relationships, and evaluating the performance outcome of the decision to outsource.

The available management and social science electronic resources were reviewed to identify five potential databases: *SciVerse Scopus*, *EBSCOHost Business Source Complete*, *Proquest ABI/Inform Complete*, *IEEE Xplore* and *Web of Knowledge*. The two leading databases of literature within the business and management domains, i.e., *EBSCOHost Business Source Complete* and *Proquest ABI/Inform Complete* were selected from the list to conduct the search. The databases were selected due to their broad coverage of peer-reviewed scholarly journals from major international publishers. The remaining three databases were not included in the search because, typically, they returned either duplicate or insufficiently relevant studies.

Search string Due to the novelty of the domain, various terms are used to describe the phenomenon of innovation outsourcing. Consequently, care is taken not to restrict the search too early. Various terms were trialled and the following search string was identified as casting a wide but appropriate net for identifying studies relating to the phenomenon: *'outsourcing and (R&D or innovation)'*.

A deliberate decision was made to exclude the term 'open innovation' from the search string. This was done to ensure that the study did not skew towards the paradigm of open innovation as its primary consideration, and that the focus remained on the antecedents, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries.

Search criteria To ensure only relevant papers are returned, where the database function allowed, the search was specified to identify the key search terms within the subject, title or abstract of papers.

2.3.2 Data selection

Data selection forms a key stage in any review where individual decisions can impact the outcome of a study. This is especially pertinent where decisions result

in the inclusion or exclusion of particular literature. Such criteria are carefully considered and explicitly stated to aid the 'trustworthiness' of the review.

Inclusion/exclusion criteria The extant and rigorous nature of the aims of this study requires that the focus of data collection be solely on papers published in journals amongst the research and practitioner community. Consequently, where possible, criteria are also specified limiting the search to journal articles, scholarly journals or academic journals and those that are peer reviewed. Although, particular books and papers published in conference proceedings may be important within this domain, they were not considered within this study because, in general, they are regarded as either insufficiently rigorous or insufficiently up-to-date. The trade and popular press are disregarded because, in general, they comprise opinion related to specific scenarios and lack sufficient rigour.

The search is specified to return only literature written in the English language. To ensure that all relevant literature ever published were identified the search was not limited by publication date.

The results for each of the database searches were cross-checked to remove duplicates and papers selected from only those journals amongst the research and practitioner community. Due to the novel nature of innovation outsourcing and keen to encompass the full range of journals that published papers relating to the domain the literature search was not further limited to papers published in specific journals.

2.3.3 Data analysis

Literature and the studies they describe have particular foci, and it is only when individual literature published over a period of time is analysed and cross-validated that a realistic picture of a domain is realised. An appropriate analysis framework provides a means for realising this aim by offering structure to the domain in order to gain a comprehensive understanding.

2.3.3.1 Analysis framework

The domain of outsourcing has attracted much attention from academics and practitioners alike over a period of time. This has resulted in the accumulation of a body of literature which has attracted survey, analysis and review. Authors of outsourcing literature reviews, organise and delineate the extant literature through categorisation.

The categorisations used by the 9 surveys of outsourcing literature identified previously are amalgamated and adapted to synthesise an analysis framework to provide a holistic overview of the innovation outsourcing domain. The framework comprises categories for: research studies, definition of phenomenon, research aims, research policy, reference theory, perspective, and abstraction. Individual elements of the framework are detailed below:

Research studies Each relevant study is categorised to identify who has undertaken research in to outsourcing innovation, where it is was conducted and when.

1. *Author(s)*: the authors of innovation outsourcing papers are noted to ascertain those who are most active within this research domain by virtue of the number of papers published.

2. *Year of Publication*: Data pertaining to the year that innovation outsourcing papers are published enables the identification of when interest in this research domain commenced and for how long this interest has been sustained. It also enables identification of trends of interest within the domain, for example, whether interest has increased or declined over particular periods of time. Analysis of trends may provide information as to notable events within the study of the domain.

3. *Journal*: this refers to the journal in which a paper is published. This enables us to ascertain both the specific journal and the type of journal, (for example, management journal or economic journal), which has the most influence within this domain.

4. *Country*: This relates to the nationality of the university or organisation to which the author cited first is associated when the paper was published. From this we ascertain the diversity, and concentration of countries that contribute to the research domain of innovation outsourcing.

Definition Innovation outsourcing is a relatively novel concept where a widely accepted definition does not yet exist. How a paper understands innovation outsourcing impacts the study. Each paper is categorised depending on whether a definition for innovation outsourcing has been explicitly stated, is implied or is not defined.

Research Aims Outsourcing is viewed, broadly, as a three stage management process of decision, implementation and outcome. Firstly, undertaking the *decision* of why and what to outsource. This is a strategic management decision, which fundamentally examines what an organisation should choose or choose not to undertake, determining the extent and nature of the boundaries of the enterprise. The second stage determines how to *implement* the decision originating from the first stage. The final stage identifies the *outcome* resulting from the implementation of the outsourcing decision.

Each paper is categorised according to which of the three stages of the outsourcing management process its research objectives address. The research objectives of a paper can address more than one stage of the outsourcing management process.

Research Policy To understand how the outsourcing research community is setting about fulfilling its aims the research policy employed is examined. Each paper is examined and categorised according to its research policy, i.e., the philosophy, approach, strategy, time horizon and purpose that it adopts. In doing so, the methodologies and scope of outsourcing research are identified.

1. *Philosophy*: The foundation of any research enquiry is its philosophical perspective on the nature of reality, (i.e., ontology), and acquiring knowledge of that reality, (i.e., epistemology). The philosophical perspective drives the

research methodology. The philosophy adopted by each paper is categorised according to its tendency for positivism, interpretivism or realism.

2. *Approach*: In general, most research studies are either inductive or deductive in their approach, i.e., their tendency is to either build knowledge or to verify knowledge. An inductive approach involves careful observation, description and measurement of phenomena. The attributes of the phenomena are then classified to categories prior to identifying relationships between the categories of attributes. A deductive approach uses existing models, frameworks and theories to predict ex post what will be seen in other sets of historical data or to predict what will happen in the future (Christensen, 2006).

   For each paper, the tendency of its research approach is identified as either inductive or deductive. In some papers, the research approach is explicitly stated. Where it is not stated a subjective judgement is made.

3. *Strategy*: Research strategy is the 'general approach taken in an enquiry' (Robson, 2002), which should reflect and be appropriate to the research questions and objectives of the study. The strategy for each paper is identified, for example: regression analysis, questionnaire survey, interview survey, case study and mathematical model.

4. *Time Horizon*: Research may seek to describe the incidence of phenomena at a particular time or study the changing development of phenomena over a period of time. Each paper is categorised as either cross-sectional or longitudinal in the time horizon of its study.

5. *Purpose*: Studies can be classified in terms of their purpose, i.e., exploratory, descriptive or explanatory (Robson, 2002). Exploratory studies seek to identify what is occurring with respect to phenomena and to provide new insights of the phenomena. Descriptive studies portray an accurate account of a situation with a view to evaluating it to synthesise new insights. Explanatory studies analyse and identify relationships between attributes of phenomena.

Reference Theory Outsourcing is a complex phenomenon which cuts across many functions. Due to this, practitioners and academics have ascribed a diverse range of theories to explain the phenomenon. Papers are identified according to whether they subscribe to a theory or theories.

Perspective Outsourcing innovation often involves numerous parties with differing and often contradicting priorities. Papers tend to review the outsourcing phenomenon from one or more perspectives. The perspective or perspectives are identified from which the outsourcing phenomenon is viewed for each paper. The categories under which each paper is categorised are from the perspective of the: outsourcer, vendor, relationship between the outsourcer and vendor, or other.

Abstraction The level(s) of abstraction that each paper describes is identified, i.e., the industry sector, the nation/country, the firm or the employee.

2.3.3.2 Analysis strategy

The framework is applied to the objectives of this review to formulate an analysis strategy. An overview of the analysis strategy which displays the categorisation of literature to inform the objectives of this review is displayed in table 2.2, and detailed below:

Review Objective	Categorisation used to inform Objective
What is innovation outsourcing?	Research studies Definition Reference theory
What is the significance of innovation outsourcing?	Research studies Research aims Research policy
What are the key issues associated with innovation outsourcing?	Research studies Research aims Research policy Perspective Abstraction

Table 2.2: Strategy for analysing innovation outsourcing literature

1. Definition and general concept - Each paper is analysed to identify whether and how their use of the innovation outsourcing concept is defined.

2. Significance of innovation outsourcing - The number and trend of papers is used to identify whether innovation outsourcing is an important area of research.

3. Focus and trends of research - Identify and categorise the various areas of research within the innovation outsourcing domain, including methodologies used to conduct the research. Gaps in knowledge and potential areas for future research are identified.

2.4 Results & analysis

A search of the databases, *EBSCOHost Business Source Complete* and *Proquest ABI/Inform Complete* using the search string *outsourcing and (R&D or innovation)* returned 674 and 434 papers respectively for the period up to and including 31st July 2012.

The complete list of 1108 papers was filtered to remove duplicates, conference papers and book reviews. The abstracts of the remaining papers were read to remove those papers that are clearly irrelevant to the domain, for example, those papers that are only concerned with innovation *within* outsourcing. The remaining papers were read in detail to ensure their relevance to the domain of innovation outsourcing. During the detailed reading of the papers care was taken to note any reference to significant papers which may have been missed during the search. This resulted in a final list of 248 papers which are analysed to inform the objectives of this review. The analyses and their outcomes are detailed below.

2.5 Definition and general concept

A review of the literature identifies that there does not exist a widely accepted definition. Only 8 of the total 248 papers explicitly state a definition for their use of either the term 'innovation outsourcing' or 'R&D outsourcing'. These are variously defined as:

> 'Outsourcing R&D is concerned with the antecedents, processes, and implications of sourcing innovation from players outside the firm's boundaries' (Hsuan and Mahnke, 2011)

> 'projects and services contracted in the markets for technology' (Lucena, 2011)

> 'to acquire external technological knowledge that is subsequently integrated into a firm's own knowledge base' (Grimpe and Kaiser, 2010)

> 'Offshoring refers to the process of sourcing and coordinating tasks and business functions across national borders. Offshoring may include both in-house (captive, or international in-sourcing) and, increasingly, outsourced activities that are performed by an external provider - that is, from outside the boundaries of the firm' (Lewin et al., 2009)

> 'a firm acquires external technology via purchasing contract' (Chen and Yuan, 2007)

> 'a strategic decision which enhances a firm's capabilities by substituting or complementing its internal innovation activity with that sourced externally via a formal agreement' (Love and Roper, 2001). This definition is sanctioned by (Chiesa et al., 2004) and (Gooroochurn and Hanley, 2007).

The remaining 240 papers do not explicitly define the term 'innovation outsourcing' or 'R&D outsourcing'. Some papers attempt to describe the term or concept using synonyms, e.g., technology sourcing (Ford et al., 2012), technology sourcing (O'Regan and Kling, 2011), open innovation (Albors-Garrigos et al., 2011), distributed product development (Amaral et al., 2011), outsourcing of new product development (Ciravegna and Maielli, 2011), etc. Other papers attempt a description of the term or concept based on various but limited characteristics, e.g. external sourcing, virtual organisation, capabilities, etc. Some papers do

not even attempt a description of the term or concept, presumably on the understanding that they are self explanatory, e.g., 'innovation outsourcing' described as an amalgamation of widely accepted definitions of the terms innovation, e.g., (Tidd et al., 2005) and outsourcing, e.g., (McIvor, 2005).

To imply a definition of innovation/R&D outsourcing using synonyms, a limited number of characteristics, or as an amalgamation of terms disregards the specific complexities associated with the concept. The range of characteristics and theories underlying the concept of innovation/R&D outsourcing are identified from the literature and evaluated to synthesise a generic definition.

2.5.1 Characteristics

Characteristics of innovation outsourcing are elucidated from the literature and used towards constructing a generic definition.

External sourcing The notion of external sourcing as a characteristic of innovation outsourcing is universal amongst the literature. The literature, however, differs in terms of describing what is being sourced. This may be innovation activity (Love and Roper, 2001), knowledge (Grimpe and Kaiser, 2010), new product development (Ciravegna and Maielli, 2011), R&D services (Martinez-Noya and Garcia-Canal, 2011), ideas (Baloh et al., 2008), or competencies (Sen and Haq, 2011).

Much of the literature when referring to external sourcing implicitly refers to it within the context of onshore outsourcing of R&D. The literature differentiates outsourced innovation when it is sourced overseas referring to it as 'offshore innovation', 'outsourced offshore innovation', international R&D outsourcing (Garca-Vega and Huergo, 2011), or simply 'offshoring'. If the latter term is used, care should be taken to ensure that it does not refer solely to the location or relocation of a firm's facilities overseas.

Boundary Closely associated with what is being sourced is the boundary across which it is sourced. The boundary is variously described in terms of the firm (Hsuan and Mahnke, 2011), culture, geography & legal (Amaral et al., 2011),

knowledge (Grimpe and Kaiser, 2010), and financial transactions (Chen and Yuan, 2007). Whilst these individual descriptions of the internal/external boundary are not incorrect, they do not capture the complexity of the boundary. It may be better to describe the notion of external sourcing as being across firm boundaries to ensure that any definition captures the boundary's various facets and the complexity of managing across them.

A strategic decision Innovation outsourcing is characterised as a strategic decision because it concerns a business function which is an important component of long run business advantage. Outsourcing can help organisations to achieve sustained innovation and continuous competitive differentiation (Baloh et al., 2008). This is supported by (Love and Roper, 2001) and (Quinn, 2000) who state that firms should 'systematically tap the capabilities of external knowledge leaders, not just for state-of-the-art products and services but also for the continuous innovation and evolution of ideas that will keep companies at the frontier of their industries'.

Degree of integration The degree of integration is used as a characteristic to differentiate between innovation that occurs within the firm and that which is externally sourced. innovation outsourcing is described as being somewhere 'between centralized arrangements and decentralized open-source networks' (Amaral et al., 2011).

Complement/substitute In common with some definitions of general outsourcing, (e.g., '... the sourcing of goods and services *previously* produced internally within the sourcing organisation from external suppliers' (McIvor, 2005)), some of the innovation outsourcing literature considers innovation outsourcing to be only a substitute to existing innovation activity. In such cases, it is usually considered in association with the notion of 'collaboration' as a means for complementing existing innovation activity.

The general opinion, however, is that terms such as 'collaboration' and 'alliances' are modes of innovation outsourcing, and that innovation outsourcing as a concept can act as both a complement and substitute for existing innovation

activity. For example, 'contract innovation services providers to supplement or even replace internal efforts' (Stanko and Calantone, 2011), and '... can be used to both substitute and complement a firm's internal activities' (Love and Roper, 2001).

Determinants Ultimately, firm decisions to outsource innovation are in response to their external environment. Various factors include: increased globalisation, (i.e., the dismantling of national barriers relating to markets and production), drives outsourced R&D (Sener and Zhao, 2009) (Ernst, 2006); global and industry uncertainty (King, 2006); increasing focus on economies of scope (Birchall et al., 2001) (Chesbrough and Crowther, 2006), and; a global race for talent (Lewin et al., 2009). Predictive characteristics of firms which have a propensity to outsource R&D include: small-medium size of firm (Sen and Haq, 2010); high exploratory research intensity (Calantone and Stanko, 2007) (Rundquist and Halila, 2010); declining productivity (Higgins and Rodriguez, 2006), and; firms that place a high value on learning effects and currently possess a low level of knowledge are more likely to outsource innovation (Calantone and Stanko, 2007).

Process The innovation outsourcing process is described simplistically as two discrete and independent steps of selection and implementation (Murray et al., 2009). Selection involves protecting core competencies (Festel et al., 2011) (Giao et al., 2008). Implementation involves spanning the boundary comprising the specification of projects, sharing information systems, relationship management and governance (Amaral et al., 2011).

Outcomes Performance outcomes of innovation outsourcing are treated at a conceptual level in terms of an optimal level of innovation outsourcing. There is an inverted U-shaped relationship between R&D outsourcing and innovation performance (Grimpe and Kaiser, 2010) (Kotabe et al., 2008) (Rothaermel et al., 2006). There is a 'tipping-point' beyond which increasing R&D outsourcing leads to negative innovation returns on innovation performance. Negative outcomes of innovation outsourcing due to the hollowing out of competencies are described by

(Ciravegna and Maielli, 2011) (Amaral et al., 2011). The majority of the literature describes outcomes in terms of expected benefits (Howells et al., 2008) (Cass, 2007) (Piachaud, 2002): cost reduction; increased speed to market; rapid exploitation of technology; spreading risk; enhanced strategic focus, and; increased flexibility.

Modes The concept of innovation outsourcing is widely described in terms of the methods by which it is achieved, i.e., mode. Various modes used to characterise innovation outsourcing are: Collaborative new product development (NPD) (Ciravegna and Maielli, 2011), R&D spinouts (Festel et al., 2011), open source (Baloh et al., 2008), licensing (Nambisan and Sawhney, 2007), and R&D contract (Chatterji, 1996).

Formality of agreement Some literature emphasise the formal nature of agreements when outsourcing innovation, e.g., '... innovation activity with that sourced externally via a formal agreement' (Love and Roper, 2001), and 'a firm acquires external technology via purchasing contract' (Chen and Yuan, 2007). The formality of agreements as a characterisation of innovation outsourcing is contradicted by other literature where the informality of agreements and trust is emphasised in order to encourage innovation success (Li et al., 2008) (Plewa and Quester, 2006) (Carson et al., 2003).

Newness To differentiate the characterisation of innovation outsourcing from general outsourcing, the literature emphasises the notion of innovation as 'newness', i.e., anything new about what a company produces or how it operates (Hill and Jones, 2001). This aspect is especially highlighted by (Howells et al., 2008) who identify nine differentiating characteristics. The key aspect associated with all these characteristics is the issue of the 'unknown', i.e., it is difficult to ascertain, a priori, innovation outsourcing outcomes. This issue is pervasive throughout the innovation outsourcing process impacting the decision to outsource, implementation and outcomes.

2.5.2 Theoretical foundations

The theory or theories referenced by each paper are identified. A single paper may use more than one reference theory and all that are referenced are noted. Where a paper does not reference a theory nor apply a theoretical foundation it is categorised as n/a.

Innovation outsourcing is a phenomenon which cuts across several management disciplines. It is unsurprising, therefore, that the reference theories adopted within the innovation outsourcing literature display considerable diversity. The main theories referenced by the literature are described below.

Transaction cost economics TCE theory (Williamson, 1975) (Williamson, 1985) is the foundation of the 'make-buy' management decision which traditionally determines the boundary of the firm. TCE theory asserts that a firm's objectives are achieved through ensuring the economic efficiency of transactions undertaken via a comparative analysis of production costs and transaction costs. Difficulty of comparison arises due to the irrational behaviour of parties involved in the transaction, opportunism, information asymmetry, uncertainty and infrequency. Much of the innovation outsourcing literature, e.g., (Calantone and Stanko, 2007) (Dankbaar, 2007) (Mehta and Peters, 2007) base their studies on TCE which uses lowest unit cost as the ultimate arbiter for the decision to outsource. It is also used to explain the globalisation of innovation (Cusmano et al., 2010). The level of analysis is the transaction.

Internalisation theory This is an economic theory (Coase, 1937) which considers alternative contractual arrangements to explain the choice of arrangements to coordinate different economic activity. It is relevant in explaining the interaction between the boundary of the firm and boundaries of political states where activities are located. This is pertinent to decisions concerning location of outsourced offshore R&D facilities, e.g., markets should be considered in outsourced R&D location decisions (Buckley and Casson, 2011). The level of analysis is an industry.

Resource-based theories Resources are 'all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness' (Barney, 1991). Resource-based theories (Penrose, 1959) used within the literature assert that competitive advantage is attained if a firm possesses resources not held by others. An example of the use of resource-based theories within the literature is to explain innovation outsourcing capability as a source of competitive advantage (O'Regan and Kling, 2011). The level of analysis is the firm.

Learning theories A firm's ability to 'recognize the value of new, external information, assimilate it, and apply it to commercial ends' is termed absorptive capacity (Cohen and Levinthal, 1990). The development of absorptive capacity, encompassed in a firm's employees, communication structures and external networks, is essential to the development of innovative capabilities. Firms with high levels of absorptive capacity possess higher levels of innovative capability (Weeks and Thomason, 2011).

The way that organisations interpret their environment, perceive their experiences and develop lessons can differ. The two main styles of organisational learning are exploration and exploitation (March, 1991). The level of analysis for learning theories is the firm.

Knowledge theories The successful transfer of knowledge across firm boundaries is dependent on a firm's peripheral knowledge, i.e., prior related knowledge. Peripheral knowledge is necessary for receiving and assimilating new knowledge. The level of analysis is the firm.

Strategic management theories These relate to the strategic activities of the firm. Strategic theories referenced within the innovation outsourcing literature are concerned with how firms rationalise the management actions they take to achieve one or more of their goals. The disaggregated view of the value chain and its activities plays an important role in explaining why firms outsource innovation as explained by (Porter, 1986) 'successful international competitors in the

future will be those who seek out competitive advantages from global configuration/coordination anywhere in the value chain'.

Capabilities theories These relate to the firm-specific capabilities. The theory of dynamic capabilities (Teece et al., 1997) describes the process of renewal and change that firms can undertake to improve their competitiveness (Noke and Hughes, 2010). Firms possess specific capabilities which includes the strategic management of structures, routines, knowledge and skills to create competitive advantage. Core competency theory (Prahalad and Hamel, 1990) (Prahalad and Hamel, 1994) states that firms should protect and nurture those activities which they do better than anyone else. It is cited in the literature as reason to outsource activities that are non-core and focus on activities where the firm has a distinct advantage. The level of analysis is the activity.

Innovation theories These relate to the factors that affect innovation and the models of innovation adopted by firms. Increasingly faster innovation, inter-firm networking and the use of new technologies has led to a fifth-generation model of innovation (Rothwell, 1992).

Decision-making theories Fuzzy set theory (Zadeh, 1965) is usually adopted within the literature to provide decision-making capabilities in the presence of vague or imprecise information. The level of analysis is the decision.

2.5.3 A generic definition

The above analysis identifies innovation outsourcing as a complex, multi-disciplined phenomenon where management are required to make decisions with vague information. It is identified as a strategic decision concerning the sourcing of innovation across firm boundaries to either supplement or replace existing innovation activity using structures and procedures which integrate new knowledge within the firm. The relationship between innovation outsourcing and open innovation is clarified before synthesising a definition.

Relationship with open innovation To avoid confusion, the similarities and differences of innovation outsourcing to open innovation are highlighted. Open innovation (Chesbrough, 2003) is a new paradigm embodied in six principles which asserts that innovations do not necessarily have to originate from within the bounds of the firm to be profitable. This contrasts with the traditional closed innovation paradigm where firms wholly resource, develop, own and market their innovations from within their bounds.

Similar to innovation outsourcing, open innovation emphasises the potential of external R&D resources to create value and the building of internal capability to take advantage of it. It must be emphasised, however, that open innovation is no more than a paradigm, it '... is not ipso facto a recipe for outsourcing R&D' and that it does not '.. imply the outsourcing of the entire R&D function' (Chesbrough and Crowther, 2006). Innovation outsourcing incorporates the paradigm of open innovation and extends it to the process of its realisation, encompassing its determinants, selection, implementation and outcomes.

Definition A definition synthesised from the above analysis and adopted by this study is that innovation outsourcing is:

> *'a strategic decision involving the antecedents, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries'*

2.6 Significance of innovation outsourcing

The significance of a domain identifies whether a domain is worth studying. The literature is analysed to discover the scale and extent of interest in innovation outsourcing.

2.6.1 A growing phenomenon

The extant literature is analysed to identify the extent of interest in the innovation outsourcing domain. There has been increasing consideration of innovation outsourcing amongst both practitioners and academics. This is displayed by the

gradual rise in the number of papers published over the past twenty one years as displayed in Fig. 2.3. The number of papers for 2012 represents those for only the first seven months of the year. The earliest identified paper was published in

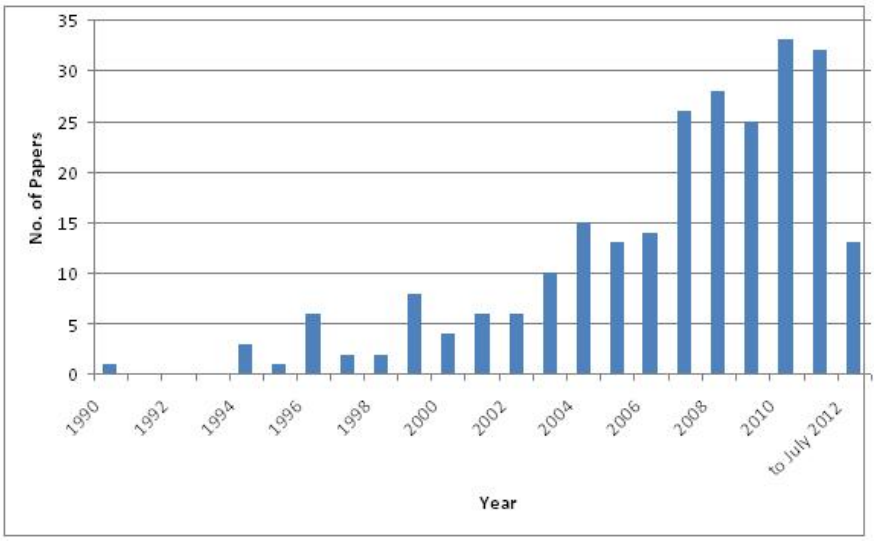


Figure 2.3: The increasing consideration of innovation outsourcing

1990. Although, (Sen and Rubenstein, 1990) do not explicitly use the terms 'outsourcing innovation' or 'outsourcing R&D' they do refer to the increasing trend of firms to look outside the firm for ideas and technology. The first explicit use of the term R&D outsourcing is by (Ulset, 1996) who explores the boundary between internal and external R&D projects and the governance mechanisms of external R&D projects. Prior to this, the number of papers within this domain is patchy; there was only one paper published in 1990 relating to innovation outsourcing and no papers published during the period 1991 to 1993 inclusive.

2.6.2 Widespread interest

The study of innovation outsourcing is widespread. It is not confined to a particular journal, research group or country.

Journal	No. of Papers
Research Technology Management	20
R&D Management	14
Industry & Innovation	11
International Journal of Innovation Management	11
Research Policy	9
International Journal of Technology Management	7
Journal of Product Innovation Management	7
Technovation	7
Harvard Business Review	6
Journal of International Management	6
MIT Sloan Management Review	6
IEEE Transactions on Engineering Management	5
International Journal of Operations & Production Management	4
Strategic Management Journal	4
Industrial & Corporate Change	3
International Journal of Innovation & Technology Management	3
International Journal of Services Technology and Management	3
Journal of Management Studies	3
Journal of Operations Management	3
Management Decision	3
Organization Science	3
Technology Analysis & Strategic Management	3
Creativity & Innovation Management	2
Economics of Innovation & New Technology	2
European Management Journal	2
Human Systems Management	2
Industrial Marketing Management	2
International Business Review	2
International Journal of Entrepreneurship & Innovation Management	2
Journal of International Business Studies	2
Journal of International Economics	2
Managerial & Decision Economics	2
McKinsey Quarterly	2
Quality Progress	2
Review of International Economics	2
Strategic Outsourcing: an International Journal	2
Structural Change & Economic Dynamics	2
Other Journals	1 Each

Table 2.3: Journals most prolific within the innovation outsourcing domain

Spectrum of journal domains The range of journals that include studies relating to innovation outsourcing are displayed in table 2.3. The spectrum of journals which cover innovation outsourcing range from those which tend to focus on the innovation function of the firm through to some that focus on the strategic and business management of the firm, and others which focus on wider research relating to economics.

Journals most prolific in their inclusion of papers concerning innovation outsourcing relate to either the innovation management function or strategic management. It is notable that these journals are applied in nature reflecting the real world focus of the domain. Innovation management journals include: Re-

search Technology Management, R&D Management, Industry & Innovation, and International Journal of Innovation Management. Strategic management journals include: Harvard Business Review, MIT Sloan Management Review, and Journal of International Management. The significance of innovation outsourcing to the macro view is evidenced by its treatment in economic journals such as Journal of International Economics and Review of International Economics.

It is notable that a large number of differing journals covering domains as disparate as technology, biotechnology, marketing and human resources have published at least one paper relating to innovation outsourcing, displaying widespread interest in this phenomenon.

Variety of research groups Innovation outsourcing is a research domain which has found interest amongst a large number of research groups. There are 210 individual lead authors who have published a total of 248 papers over 22 years. No single author dominates the innovation outsourcing domain, where the vast majority of authors have published only once as lead author. The authors most prolific within the innovation outsourcing domain are displayed in table 2.4. The three most prolific authors are J.Howells, R.K. Perrons and A.K. Sen who have published six, five, and four papers respectively as lead author. There are disparate areas of research interest amongst the authors.

International interest Universities and organisations from 27 countries are associated with papers concerning innovation outsourcing. Table 2.5 displays the number of innovation outsourcing papers associated with the differing nationalities of the university or organisation to which the author cited first in a paper is associated when the paper was published. There is a clear dominance of papers from the US over other countries, with the UK as a significant contributor in second place. The spread of other countries publishing at least one paper within this domain displays that there is wide international interest in the innovation outsourcing phenomenon.

It should be noted that the vast majority of papers originate from countries in Western developed economies such as the USA and Europe. There are, however,

Author	No. of Papers
Howells, J.	6
Perrons, R.K.	5
Sen, A.	4
Cui, Z.	3
Mol, M.J.	3
Azadegan, A.	2
Bardhan, A.D.	2
Bengtsson, L.	2
Chesbrough, H.	2
Chiesa, V.	2
Cusmano, L.	2
Festel, G.	2
Fifarek, B.J.	2
Glass, A.J.	2
MacPherson, A.	2
Martinez-Noya, A.	2
Maskell, P.	2
Narula, R.	2
Quinn, J.B.	2
Roy, S.	2
Rubenstein, A.H.	2
Rundquist, J.	2
Takeishi, A.	2
Tiwana, A.	2
Weeks, M.R.	2
Zhao, Y.	2
Zirpoli, F.	2
Other Authors	1 Each

Table 2.4: Authors most prolific within the innovation outsourcing domain

also papers originating from developing economies such as Brazil, India, China and Malaysia.

2.7 Body of knowledge - research issues

It is apparent from the literature that there are numerous and diverse studies concerning innovation outsourcing. There does not, however, exist an overall study which organises and integrates the literature. Researchers pose a variety of research questions, draw on a variety of theories and use a multitude of methods. Bringing order to this diversity is undertaken by focusing on the scope of studies, research objectives, and research approach.

Country	No. of Papers
USA	96
UK	39
Italy	14
Germany	9
Netherlands	9
Taiwan	8
China	7
Denmark	7
Spain	7
France	6
Japan	6
Sweden	6
India	5
Switzerland	5
Australia	4
Brazil	3
Canada	3
Finland	3
Norway	3
Austria	1
Belgium	1
Iran	1
Lithuania	1
Malaysia	1
Portugal	1
Singapore	1
Slovenia	1

Table 2.5: Countries most prolific in innovation outsourcing research

2.7.1 Scope of innovation outsourcing

Having identified that innovation outsourcing is an area of research that is considered important by researchers and practitioners, it is appropriate to identify to whom it is important and why. The scope of innovation outsourcing concerns the span and relevance of its implications. Each paper is reviewed and categorised according to which of the four levels of scope its outcomes address: industry, nation, firm or employee. A paper can address more than one level of scope. Table 2.6 displays the number of papers referencing each level of scope.

Abstraction	No. of Papers
Industry	56
Nation	49
Firm	233
Employee	10

Table 2.6: Scope of innovation outsourcing

Industry Industry sector as a level of abstraction is addressed by 56 papers out of a total of 248 innovation outsourcing papers. The industries considered within the literature are diverse and include the pharmaceutical (Kleyn et al., 2007), investment banking (Grote and Taube, 2007), manufacturing (Dankbaar, 2007), and minerals (Upstill and Hall, 2006).

Nation Nation as a level of abstraction was addressed by 49 papers out of a total of 248 innovation outsourcing papers. It is considered as either a generic notion or as a specific country. Papers using nation as a generic notion tend to be economic studies which formulate and analyse economic models to explore specific aspects of innovation outsourcing, e.g., (Frenken, 2006) (Rothaermel et al., 2006). The nation is a particular emphasis within papers focusing on the developing economies, especially China as it seeks to capitalise on the influx of foreign R&D by building a national innovation infrastructure (Chen and Yuan, 2007) (Yifei et al., 2007). Other specific nations addressed by innovation outsourcing literature include Australia (Upstill and Hall, 2006) and Russia (Bardhan and Kroll, 2006).

Firm The vast majority of papers, 233 out of a total of 248, addressed innovation outsourcing from the level of the firm reflecting it as a strategic management consideration (Calantone and Stanko, 2007) (Dankbaar, 2007).

Employee Employee as a level of abstraction was addressed by only 10 papers out of a total of 248. Key themes explored in such studies include: learning and knowledge (Chen, 2005) (Miozzo and Grimshaw, 2005); and, effective employment contracts for innovation (Zenger and Lazzarini, 2004) (Storey et al., 2002).

2.7.2 A firm-centric phenomenon

The scope of innovation outsourcing identifies it as a firm-centric phenomenon. Fundamentally, it involves two parties, an outsourcing firm and a vendor which services the needs of the outsourcing firm. The literature is reviewed to identify where the focus of the phenomenon resides, within the outsourcing firm, the vendor firm, or the relationship between the outsourcing and vending firms.

The perspective considered by researchers and practitioners within the extant literature is reviewed. Each paper is categorised according to which of three perspectives it addresses: outsourcer, vendor or relationship. The perspective categories under which each paper is categorised are not mutually exclusive and a single paper may be placed in more than one category. Table 2.7 displays the results of this categorisation. The vast majority of the research papers reviewed,

Perspective	No. of Papers
Outsourcer	234
Vendor	29
Relationship	81
Other	0

Table 2.7: Perspectives considered within innovation outsourcing

234 out of a total of 248, included the perspective of the outsourcer. This reflects innovation outsourcing as a management-led phenomenon as firms seek greater value from their innovation functions (Nambisan and Sawhney, 2007).

Significantly fewer papers, 81 out of a total of 248, referenced the importance of relationships between outsourcers and third-parties. Some themes explored in innovation outsourcing papers are effective organisational structures for innovation outsourcing, leadership, equity of relationship, trust and knowledge transfer (Kleyn et al., 2007) (Maskell et al., 2007) (Mukherjee and Ray, 2007) (Tiwana and Keil, 2007). There is only nominal consideration, 29 of the 248 papers, of the vendor perspective in the literature.

2.7.3 Innovation outsourcing as a management process

Analysis of the journals identifies innovation outsourcing as an applied strategic management phenomenon. Consequently, organising the knowledge related to innovation outsourcing is best understood as an on-going management process involving management decision-making and the evaluation of outcomes. Research objectives are categorised according to innovation outsourcing stages: decision, implementation and outcome.

The decision stage is where firms consider and weigh up the pros and cons of innovation outsourcing. They address fundamental questions such as: 'who' should outsource - e.g. whether particular industry sectors are more amenable to innovation outsourcing than others; 'why' a firm should outsource innovation - e.g., the conditions where its consideration arises and the associated risks and benefits of innovation outsourcing; 'what' to outsource - e.g., the consideration of whether only certain elements or activities of the innovation cycle be outsourced. After deciding to outsource innovation, the firm is confronted with 'how' to outsource innovation. Typically, the implementation stage considers approaches, techniques and practices for implementing innovation outsourcing. The outcome stage of the innovation outsourcing process is where firms review and evaluate the results of their decision to outsource innovation. Firms assess whether the decision to outsource innovation has been a success, identify any lessons learned from the process and whether any improvements could be made.

The aims of research papers are reviewed and analysed to ascertain the scope of the innovation outsourcing management decision process that the studies address. Each paper is categorised according to which of the three stages of the outsourcing management process, (i.e., decision, implementation and outcome), its research objectives address. Table 2.8 displays the number of papers whose research aims address specific stages or combination of stages of the innovation outsourcing process. The overwhelming focus of literature, (i.e., 89%, of the total number of papers), is on the decision stage of the innovation outsourcing management process. There are significantly fewer papers addressing the implementation stage, (i.e., 47%, of the total number of papers), and very few papers, (i.e., only 12% of papers), that address the outcome stage.

Innovation Outsourcing Stage(s)	No. of Papers
Decision + Implementation + Outcome	7
Decision + Implementation	88
Decision + Outcome	14
Decision Only	111
Implementation + Outcome	4
Implementation Only	18
Outcome Only	6

Table 2.8: The research aims of innovation outsourcing studies

Although, this observation underlines the novelty of innovation outsourcing, the significant proportion, i.e., 35%, of papers that address both the decision and implementation stages within their research aims suggest that the investigation of innovation outsourcing by researchers and practitioners is beyond the embryonic research phase. Innovation outsourcing research, however, is far short of maturity with only four papers addressing the implementation stage in conjunction with the outcome stage. There are seven papers that address the complete innovation outsourcing process through all three stages.

2.7.4 Research policy

Research policy refers to the approaches and methods used by innovation outsourcing research studies. Approaches are concerned with the overarching way that studies go about their research, whilst methods are concerned with the techniques and procedures that studies employ. Identifying the research policy of innovation outsourcing studies enables an understanding of the nature of the research, i.e., the context in which innovation outsourcing knowledge is developed. How well particular research policies fulfil the aims of studies can help guide the formulation of future studies.

Research philosophy Research philosophy refers to the notion of acceptable knowledge. Two opposing philosophical stances are positivism and interpretivism. Positivism holds the position that the social world can be studied in the same manner as the natural sciences. Positivism entails the generation of hypotheses which are tested to enable assessment of laws. Interpretivism takes the

position that the social sciences are different to the natural sciences because they involve human action. The emphasis in interpretivism is on the explanation of human behaviour. A philosophical stance between positivism and interpretivism is realism which holds that there is a reality that can be observed and understood.

Each of the 248 papers is categorised according to whether it subscribes to a positivist, interpretivist or realist philosophy. Where a study does not explicitly state the philosophy to which it subscribes, a subjective judgement is made. The results of this categorisation are displayed in Fig. 2.4. Almost equal number of

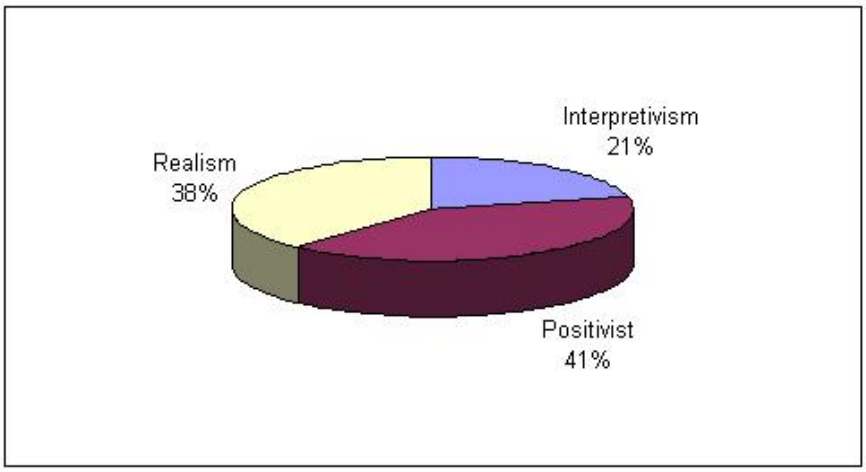


Figure 2.4: Research philosophy adopted by innovation outsourcing studies

papers adopt a realist philosophy, (i.e., 38%), to their study as do those that adopt a positivist approach, (i.e., 41%).

The adoption of a realist approach by papers reflects the real world nature of innovation outsourcing. The literature is not limited in the scope of real world scenarios, spanning industry sectors and geographies, for example: the investment banking sector is the subject of a real world investigation for outsourcing research by (Grote and Taube, 2007); the outsourcing of R&D through acquisitions in the pharmaceutical sector is investigated by (Higgins and Rodriguez, 2006), and innovation within the Australian minerals industry is investigated by (Upstill and Hall, 2006).

Literature adopting a positivist approach to their research, test hypotheses relating to innovation outsourcing. Hypotheses studied within the extant literature vary across the innovation outsourcing management process from decision to outcome. Formal propositions regarding the drivers of innovation outsourcing activities are made and tested by (Calantone and Stanko, 2007). They explore the links between the propensity of a firm to outsource innovation and inventory turnover, profit margin, core competency, employee sales efficiency and learning effects. The innovation strategy of Chinese firms is investigated by (Chen and Yuan, 2007). They identify the strategies a Chinese firm would choose among a series of strategies ranging from internal R&D to outsourcing and the effect of the firm's strategy on its innovation efficiency. The role of governance of outsourcing relationships is explored by (Tiwana and Keil, 2007) who test the hypothesis that peripheral knowledge, (i.e., specialised knowledge in the domain of outsourced activities) complements control in outsourcing alliances.

Only 21% of the total papers reviewed adopt an interpretivist approach to their research where they are concerned with investigating patterns relating to innovation outsourcing. Patterns studied within the innovation outsourcing literature vary from the national to the human level. For example, at the national level, (Yifei et al., 2007) consider whether China can integrate foreign R&D facilities in to a national innovation system, capture innovation value and the implications this has for the world. At the human level, patterns associated with managing the globalisation of R&D are investigated by (Bardhan, 2006) as dichotomous pairs of concepts, e.g., systemic vs. autonomous innovation and high skill vs. low skill specificity.

Approach Research approach refers to the nature of the relationship between theory and research. Essentially, there exist two research approaches to developing new knowledge, deduction or induction. The process of deduction involves developing a hypothesis based on existing knowledge and theory of a domain which is then subjected to empirical scrutiny. In contrast, the process of induction involves drawing theory from empirical observation. Simply, deduction can be summarised as theory $\rightarrow$ observations, whilst induction can be summarised as observations $\rightarrow$ theory.

Each paper is categorised according to the tendency of its research approach as either inductive or deductive. Where the research approach is not explicitly stated, a subjective judgement is made. The results of this categorisation are displayed in Fig. 2.5. Consistent with the novel nature of innovation outsourcing,

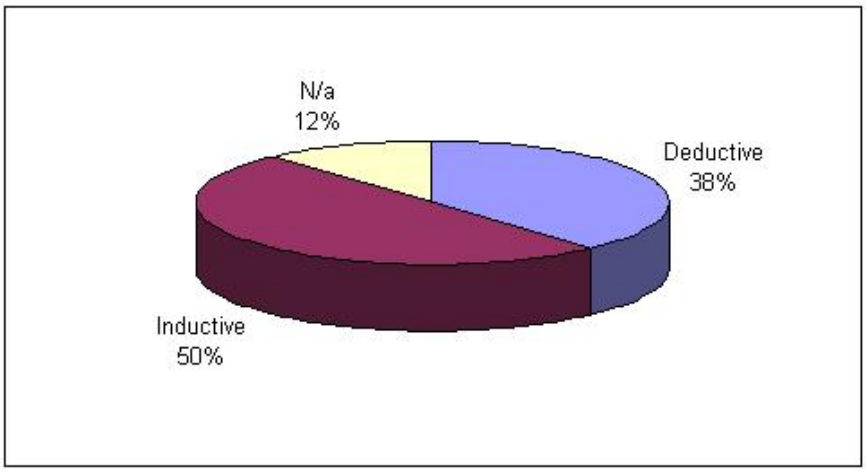


Figure 2.5: Research approach adopted by innovation outsourcing studies

the majority of papers, i.e., 50%, reviewed within this survey of literature adopt an inductive approach seeking to build theory. Studies that seek to build theory relating to innovation outsourcing include: (Nambisan and Sawhney, 2007) who organise the possibilities for externally sourcing innovation along a continuum defined by four variables; (Chesbrough and Crowther, 2006) who identify practices that appear to assist firms adopt open innovation; and (Hoecht and Trott, 2006) who utilise the concepts of trust, collaboration and network to identify the innovation-related risks of strategic outsourcing.

A deductive approach was adopted by 38% of the total papers reviewed. Literature adopting this research approach use existing theory to establish an analytical framework to test the validity of the framework and explain findings.

The remaining 12% of the total papers reviewed adopt neither a deductive nor inductive approach, and were, typically, literature which took a practitioner comment or viewpoint on innovation outsourcing, e.g., (Hunt and Williams, 2003).

Research strategy Research strategy concerns the methods used by researchers to both collect and analyse data to fulfil their research aims. Each paper is analysed to identify the research methods used to collect data and research methods used to analyse data. Examples of data collection methods include: interview survey, multiple case study. Examples of data analysis methods include: descriptive analysis, statistical analysis, and mathematical models. A paper can use a combination of methods to collect data and a combination of methods to analyse data. Where this is the case, a subjective judgement is made on the primary method used. The data collection and data analysis methods used within innovation outsourcing studies are displayed in Fig. 2.6, and Fig. 2.7 respectively.

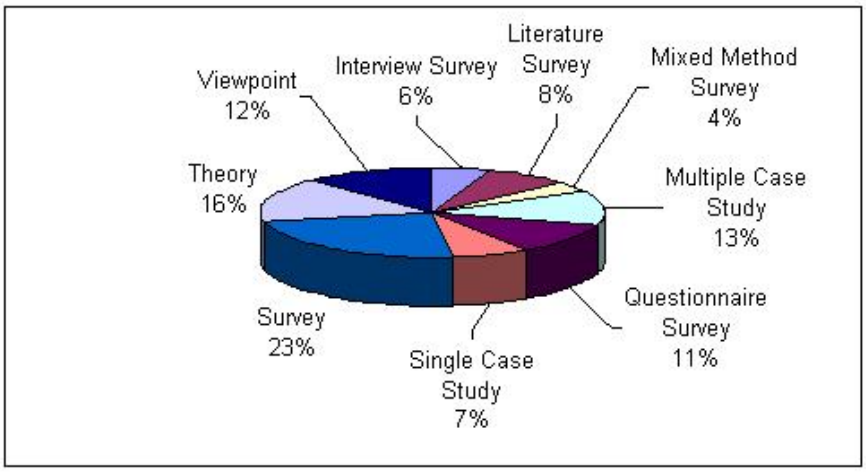


Figure 2.6: Data collection methods used by innovation outsourcing studies

Methods of data collection - There are a variety of data collection methods adopted by innovation outsourcing literature.

Surveys, (including interview and mixed method surveys), adopted by 35% of papers is the approach most commonly used by innovation outsourcing studies. Surveys are a useful means for gathering valid, reliable, rich data, especially where the study is exploratory in nature, such as (Dankbaar, 2007) and (Grote and Taube, 2007). Questionnaire surveys, (defined, exclusively, as those where the respondents record their own answers including postal surveys but excluding

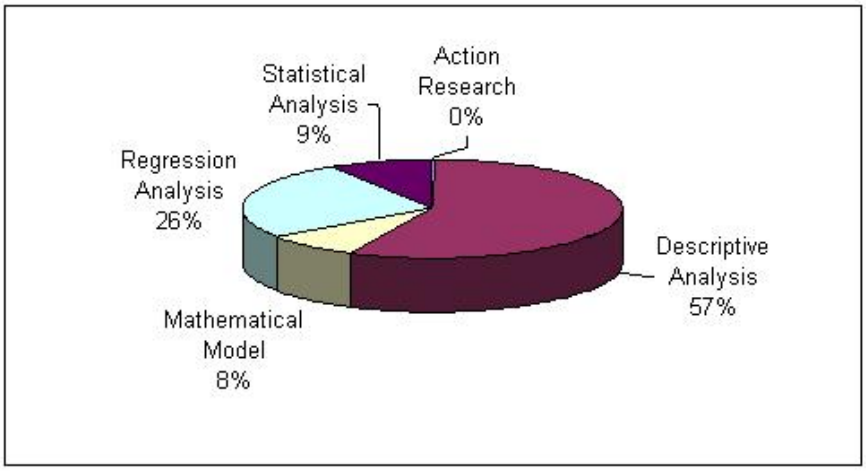


Figure 2.7: Data analysis methods used by innovation outsourcing studies

interview surveys), are adopted by 11% of innovation outsourcing studies. The advantage of such a research strategy is that it enables a large data sample. Innovation outsourcing studies employing this research strategy include: (Mehta and Peters, 2007) who explore the growth of contract research organisations in the pharmaceutical sector; (Plewa and Quester, 2006) who investigate the impact of commitment, trust and championship in university-industry relationships; and, (Storey et al., 2002) who investigate the role of flexible employment contracts in innovation productivity.

Case studies, (single-case and multiple-case), are adopted by 20% of the total literature reviewed. This reflects the novel and exploratory nature of innovation outsourcing research where the focus is on: documenting a phenomenon within its organisational context; exploring the boundaries of a phenomenon; and, integrating information from multiple sources (Eisenhardt, 1989). An example of innovation outsourcing literature adopting this strategy is (King, 2006) who uses the case study of Lockheed Martin to explore the implications of uncertainty on firm innovation outsourcing decisions. Other innovation outsourcing literature adopting the case study research strategy include (Medina et al., 2005) (Miozzo and Grimshaw, 2005) and (Chiesa et al., 2004).

Viewpoint, a term used to express a method where a descriptive approach

to a particular theme within innovation outsourcing is employed, is adopted by 12% of papers reviewed. Studies employing such a strategy tend to be informal, do not use primary data and are, typically, published in literature targeted at a practitioner audience. Examples of such studies are those published in McKinsey Quarterly (Bout et al., 2004).

Methods of data analysis - Descriptive analysis, including one paper that uses action research, is the primary method of analysing data which is adopted by 57% of papers. This reflects the novel and exploratory nature of innovation outsourcing research where the focus is on: documenting a phenomenon within its organisational context; exploring the boundaries of a phenomenon; and, integrating information from multiple sources (Eisenhardt, 1989).

Quantitative methods of data analysis, (mathematical models, regression analysis and statistical analysis), are adopted by 43% of papers. Mathematical models as a research strategy are used extensively within the economics literature. They are useful in 'what-if' scenarios where situations are mathematically defined and exercised with propositions to gain greater insight in to an issue. Studies adopting this as a research strategy include (Mukherjee and Ray, 2007) who consider a monopolist input supplier's incentive for outsourcing and R&D.

Regression analysis involves examining relationships, differences and trends using statistics and is adopted by (Higgins and Rodriguez, 2006) who examine the performance of 160 pharmaceutical acquisitions to find evidence that firms realise significant positive returns by outsourcing innovation. Regression analysis is also used by (Rothaermel et al., 2006) to provide support for the notion that carefully balancing vertical integration and strategic outsourcing when organising for innovation helps firms to achieve superior performance. Other studies adopting regression analysis as a research strategy include (Mol, 2005) (Mol et al., 2005) (Cesaroni, 2004) and (Narula, 2004).

Research literature can provide a valuable background resource to an enquiry. Its use as a research strategy is adopted by 8% of the innovation outsourcing literature reviewed, including (Badir et al., 2005), who derive organisational attributes from existing literature to develop a conceptual model for networked new product development.

Time Horizon The time horizon of a study concerns whether the research is a 'snapshot' at a particular time or an observation of changes over a period. A paper's study is described as either cross-sectional if it describes the incidence of phenomena at a particular time, or longitudinal if it considers the changing development of phenomena over a period of time. Each paper is categorised according to whether the study is cross-sectional or longitudinal, the results of which are displayed in Fig. 2.8. Reflecting the novelty of innovation outsourc-

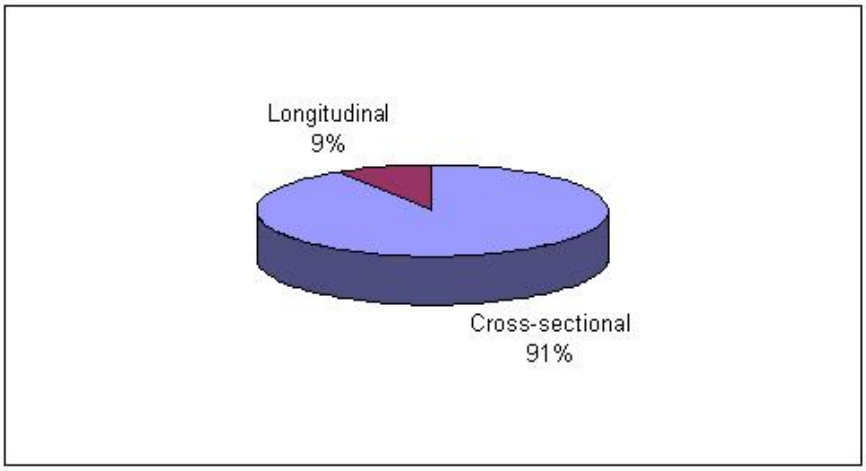


Figure 2.8: Time horizon of innovation outsourcing studies

ing, 91% of the papers reviewed undertook cross-sectional studies, whilst only 9% took a longitudinal perspective. Literature undertaking longitudinal studies include: (Upstill and Hall, 2006) who review broad international trends in innovation within the minerals industry; (Leiponen, 2005) who develop a model to highlight the conditions under which internal or external modes for organising innovation activities are likely to occur; (Paoli and Prencipe, 1999) who argue that the virtual corporation does not hold as a universal model throughout various industrial sectors; and, (Prencipe, 1997) who argues for a new organisational logic for vertical integration, outsourcing and R&D strategies.

Research Purpose Research studies can have different purposes, to find out what is happening, why something is happening, or to portray something accu-

rately. An exploratory study is a means for finding 'what is happening; to seek new insights; to ask questions and to assess phenomena in a new light' (Robson, 2002). An explanatory study is a means for establishing causal relationships between variables (Saunders et al., 2009). A descriptive study is a means to 'portray an accurate profile of persons, events or situations' (Robson, 2002).

Each paper is categorised according to the purpose of the study undertaken, i.e., exploratory, descriptive or explanatory. The results of this categorisation are displayed in Fig. 2.9. The overwhelming majority of the research studies

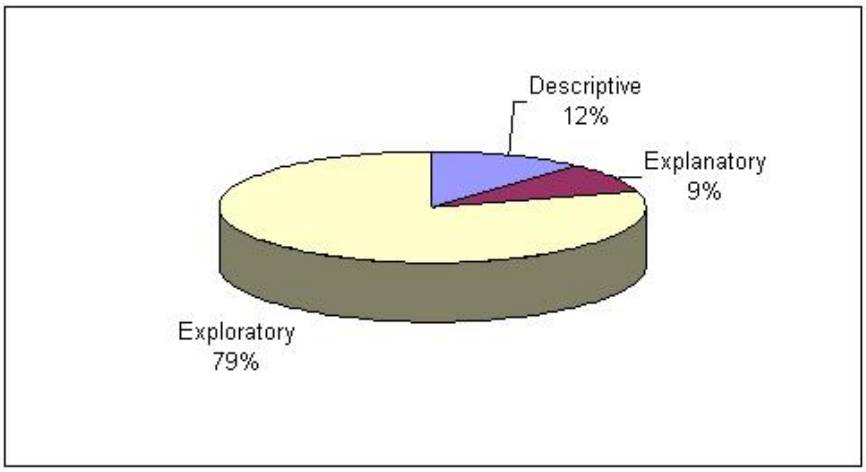


Figure 2.9: The research purpose of innovation outsourcing studies

in the innovation outsourcing papers reviewed were either exploratory, 79%, or descriptive, 12%, in nature. These statistics reflect that although the outsourcing of innovation has been on the rise for some years, research in this area lags behind industry practice. Researchers are using industry-level data to shed light on key aspects of the innovation outsourcing phenomena and understand the implications for managers (Calantone and Stanko, 2007).

Only 9%, of the research studies in the papers reviewed were explanatory in nature. Most of the explanatory studies were published in 2007 with one study published in 2006. There aren't any studies of an explanatory nature prior to 2006. Studies of an explanatory nature include: (Dankbaar, 2007) who explain why firms continue to maintain research as an in-house activity when development

and manufacturing have been outsourced; and, (Grote and Taube, 2007) who explain the conditions when innovation outsourcing is not an option.

2.8 Innovation outsourcing process analysis

Innovation outsourcing has implications for industry sectors and national government policy as well as for firms. It is, however, ultimately a firm phenomenon because that is where the decision on whether to outsource or not is made. It is correct, therefore, that the vast majority of the literature focuses on the firm perspective.

2.8.1 Firm perspective

The analysis framework is used to identify the different foci of researchers from the perspective of various combinations of stages of the innovation outsourcing process.

2.8.1.1 Decision stage

The decision stage is the focus of the majority of studies concerning innovation outsourcing. There are 101 papers which consider only the decision stage of the firm innovation outsourcing process. Firm decisions associated with innovation outsourcing are various.

The rationale why firms outsource is identified by (Howells et al., 2008) (Cass, 2007) (Piachaud, 2002). Reasons and expected benefits include: cost reduction; increasing speed to market; rapid exploitation of technology; spreading risk; enhanced strategic focus; increased flexibility, and; to gain a window on new technologies.

A key consideration of firms when outsourcing is protecting core competencies (Sen and MacPherson, 2009) (Festel et al., 2011). Firms are required to analyse processes at the level of activities, (i.e., a set of related tasks, performed by a single entity resulting in specific deliverables), to identify core and non-core activities (Amaral et al., 2011).

Firms can outsource almost any element in the innovation chain, from basic research through to advanced development, from raw ideas to market-ready products. Determining which innovation activity to outsource requires consideration of industry/market factors and company factors (Nambisan and Sawhney, 2007).

Firms base their decisions on where to outsource using a narrow set of reasons, (e.g., lower 'linkage' costs and lower employee turnover) (Amaral et al., 2011). Location decisions should be made with due consideration of a comprehensive framework of both macro and micro factors to maximise outsourced innovation performance.

Different innovation needs require differing modes of innovation. Consequently, firms need to make choices concerning the modes of R&D outsourcing that best fit their needs. The choice of innovation outsourcing mode is defined by (Baloh et al., 2008) as a strategic choice within a three-dimensional space whose axes are: scope of innovation; impact on existing business strategy, and; need for customisation.

The selection of suitable partners for outsourcing R&D is a key strategic consideration. Selecting partners from a large number of possible suppliers with various levels of capability and different potentials is a complex multi-criteria decision-making problem with both qualitative and quantitative factors (Cui et al., 2009).

2.8.1.2 Implementation stage

There are 15 papers which consider only the implementation stage of the innovation outsourcing process adopting a variety of research policies in their studies.

The implementation of outsourced innovation by SMEs, (small and medium-sized enterprises), is the focus of a study by (Albors-Garrigos et al., 2011). They analyse a number of variables associated with outsourcing innovation such as: organisation, industry environment, strategy, structure, R%D policies and absorptive capacity. They identify: environment shapes organisation strategy and structure; the highest innovation performance is attained by firms with organic organisation structures; effective transfer of technology is dependent on being aware of cultural, strategic and technological differences.

A vendor perspective is adopted by (Chou and Yen, 2009) to describe two models of R&D service firms and their respective strengths and weaknesses. They propose a vendor operational model which combines the strengths of both, a virtual contract research organisation.

Firms with overseas R&D subsidiaries and tight global workflow should create strong local outsourcing linkages to increase connectivity and innovation potential (Boehe, 2007).

Firms are faced with the issues of matching organisation structure, management practices and business procedures when outsourcing of R&D overseas. A set of variables are presented which firms must address to effectively outsource innovation: nature of innovation, (i.e., drastic or incremental); labour skills specificity; market strategy, and; coordination & control (Bardhan, 2006).

Championship, trust and commitment are positively associated the successful implementation of innovation outsourcing relationships (Plewa and Quester, 2006). Whilst this is supported by (Carson et al., 2003), the performance of trust-based governance is contingent on partner firms being able to 'read' each other and learn counterpart behaviour (Carson et al., 2003).

Effective management of intellectual property when outsourcing innovation is essential. A model for its implementation is proposed by (Fitzpatrick and DiLullo, 2005), comprising: partner identification and screening; partnership negotiations; structuring partnering relationships, and; administering & terminating IP-based partnerships.

Employee performance attributes differ between internal R&D and that which is outsourced. Consequently, measures of employee ability, performance and effort should be reviewed when outsourcing innovation and employment contracts that are incentive-intensive for innovation outsourcing should be implemented (Zenger and Lazzarini, 2004).

Managing knowledge in R&D outsourced relationships is not easy (Takeishi, 2002): opportunities for attaining relevant knowledge through learning-by-doing may be missed; knowledge may be diffused to competitors, component-specific and architectural knowledge may be diluted. Knowledge partitioning should be differentiated from task partitioning when outsourcing innovation. Organisational mechanisms for managing knowledge should include: career development policies;

extensive documentation of technological information; internal training programs and incentive schemes.

Firms should implement clear frameworks and decision-making processes for identifying the most appropriate mode for outsourcing innovation (Chiesa et al., 2000).

2.8.1.3 Decision-implementation stage

There are 88 papers which consider the decision-implementation stages of the firm innovation outsourcing process. The foci of research for paper that consider the decision-implementation stage are various. Key aspects are outlined below.

Modularity is a key concept when outsourcing innovation. Increased modularity of R&D products and processes aids R&D outsourcing. Modularity concerns the distinction between subsystems in a given system (Grote and Taube, 2007). It refers to the degree of coupling between subsystems; the looser the coupling between subsystems, the greater the modularity. Complex products are not completely decomposable (Zirpoli and Becker, 2011a). Attempting to decompose knowledge for anything other than simple systems may lead to loss of meaning and control over the outsourced activity and eventually a loss of the firm's knowledge base which confers its competitive distinctiveness (Paoli and Prencipe, 1999).

Firms' strategy for outsourcing R&D determines changes in their internal R&D employment intensity (Teirlinck et al., 2010). R&D employment intensity of firms changes depending on the strategic decisions to start, increase, decrease or stop outsourcing.

Establishing a culture open to and willing to engage with external parties is essential to the success of an outsourced innovation strategy (Munsch, 2004). Outsourcing innovation requires innovators to be more extrovert and to be comfortable with collaboration (Huston and Sakkab, 2007).

Absorptive capacity is the ability of a firm to learn new knowledge and quickly apply it within the firm (Rothaermel et al., 2006). The lack of organisational culture to support outsourced innovation hinders a firm's ability to integrate effectively innovation knowledge acquired from outside its boundaries.

2.8.1.4 Outcomes stage

A focus on only the outcome stage of the firm innovation outsourcing process is displayed in 5 papers which are published between 2004 and 2007. The studies focus on firm outcomes in a variety of scenarios.

Outsourcing R&D to developing economies such as China differs from outsourcing to developed economies (Yifei et al., 2007). The development of technologies as well as managerial and organisational capabilities is evolutionary and can take various paths due to a lack of well-defined national policies. The risks that arise when firms outsource functions that are at the 'heart of the competitive core of organisations' are highlighted by (Hoecht and Trott, 2006). The nature of the risks concern information leakage when collaborating in technology-intensive sectors. The outsourcing of R&D through acquisitions in the pharmaceutical sector is identified as a successful strategy for replenishing declining research pipelines (Higgins and Rodriguez, 2006).

2.8.1.5 Implementation-outcomes stages

Four papers consider the implementation and outcomes stages of the innovation outsourcing process, three of which have been published within the past 12 months. The implications of how knowledge and R&D activities are organised and coordinated when outsourcing innovation are explored by (Howells et al., 2012). Increased risks due to fragmentation of the innovation process as a result of outsourcing innovation to providers who increasingly expand their role are identified by (Lowman et al., 2012). Process and product innovation are not mutually exclusive when outsourcing innovation. Outsourced innovation is reinforced by inter-organisational practices, tools, and distinct absorptive capabilities (Bocquet, 2011). Outsourcing innovation is beneficial to firms in rapidly changing technology environments, but requires the implementation of effective governance to ensure property rights are protected (Leiponen, 2005). They also note the impact that national policies, such as competition law, can have on firms who choose to outsourcing innovation.

2.8.1.6 Decision-implementation-outcomes stages

Consideration of the innovation outsourcing process as a whole, (i.e., decision-implementation-outcomes), is a recent occurrence in the literature which has limited treatment. Only 7 out of a total of 248 studies consider the innovation outsourcing process as a whole with 4 of the 7 being published in 2011 by 3 lead authors.

Longitudinal studies by (Ciravegna and Maielli, 2011), (Zirpoli and Becker, 2011a) (Zirpoli and Becker, 2011b) consider the three stages of innovation outsourcing as a whole within the motor manufacturing sector. A single firm case study by (Ciravegna and Maielli, 2011) of the motor manufacturer FIAT is used to highlight the considerable management failures when innovation was outsourced. A failure by FIAT's management to put in place an effective business model resulted in: too much focus on cost; outsourcing core innovation activity; erosion of architectural knowledge, and; a failure to absorb and integrate new knowledge. This theme is also addressed by (Zirpoli and Becker, 2011a) and (Zirpoli and Becker, 2011b) who identify what happens when a firm outsources too much. All three studies recommend a focus on developing management capability for putting in place effective structures and procedures when outsourcing innovation. All three studies adopt a realist, inductive research policy and use descriptive analysis to analyse the data.

Cross-sectional studies address individual aspects of management capability across the innovation outsourcing process. The outsourcing of strategic technology using corporate ventures is addressed by (Chang et al., 2009). A conceptual framework for managing, (accessing, exploiting and defending), intellectual property when outsourcing in knowledge-based industries is detailed by (Roy and Sivakumar, 2011). Managing 'fit' of learning styles between the outsourcing firm and vendor is described by (Azadegan and Dooley, 2010).

Differentiating management capabilities for outsourcing innovation depending on firm performance objectives, (i.e., low-cost oriented focus or innovation oriented focus), is identified by (Bengtsson et al., 2009). They also stress the importance of organisational integration of firm strategy with innovation outsourcing strategy where the performance objectives are innovation oriented.

2.9 Key findings & knowledge gaps

A review and analysis of the extant literature has been undertaken to define a baseline of research within the innovation outsourcing domain. A structured and stepwise approach has been adopted for organising and integrating the literature using a synthesised framework. Key findings and knowledge gaps identified as a result of the analysis are detailed below.

A complex concept Innovation outsourcing is a complex multi-faceted concept comprising various characteristics encompassing several theoretical foundations.

Definition There does not exist a widely accepted definition of innovation outsourcing. A definition is synthesised from an analysis of the domain's key characteristics and is stated below.

> *'a strategic decision involving the antecedents, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries'*

A significant discipline There has been a growing interest in the innovation outsourcing phenomenon amongst academics, researchers and practitioners which has spanned 22 years. It has widespread interest across several discipline areas and countries.

An applied discipline Innovation outsourcing is a widespread firm-centric management discipline that is multi-variable.

Literature specificity The innovation outsourcing literature is diverse. Studies have low specificity. They adopt a wide variety of research philosophies, research approaches, and research strategies. They adopt a variety of time horizons and research purposes.

Holistic approach The vast majority of the studies associated with innovation outsourcing adopt a narrow focus. Only seven papers (Ciravegna and Maielli, 2011) (Zirpoli and Becker, 2011a) (Zirpoli and Becker, 2011b) (Roy and Sivakumar, 2011) (Azadegan and Dooley, 2010) (Bengtsson et al., 2009) (Chang et al., 2009) consider the innovation outsourcing process as a whole, (i.e., decision-implementation-outcomes). There does not exist a study which consolidates an understanding of innovation outsourcing. Two significant gaps in knowledge relating to innovation outsourcing are identified:

1. Incomplete theory from a management role perspective: Several authors have contributed to the discussion of innovation outsourcing from several perspectives enabling an ongoing building and gradual refinement of theory. However, there is a lack of knowledge relating to the role of management. Individual managerial competence plays a significant role and should be an explicit focus of research (Busi and McIvor, 2008).

2. Lack of capabilities framework for managing innovation outsourcing: A key consequence that innovation outsourcing has for organisations is one of building capabilities for pursuing an innovation outsourcing agenda. There is a lack of knowledge relating to the practices that an organisation should and should not embrace for pursuing an innovation outsourcing agenda.

2.9.1 Formulation of research question & aim

The lack of a complete end-to-end innovation outsourcing process that is treated as a firm-centric practice applicable across industries leads to the development of this study's research question, aim and objectives. These are stated at the start of the following chapter in section 3.1 Research issue, aim and objectives.

2.10 Summary

This chapter has adopted a structured approach to reviewing the extant literature. Although, there is an increasing body of knowledge associated with innovation outsourcing, the domain is at the exploratory stage of the research lifecycle where

researchers have yet to widely use existing studies to build future knowledge. A foundation of knowledge within the domain of innovation outsourcing is provided on which further research can be built.

Chapter 3

Research Methodology & Design

This chapter identifies a research methodology and design that fulfils this study's research objectives. Systematic consideration of all the options available to address the main issues are presented. An overview of the chapter is displayed in Fig. 3.1.

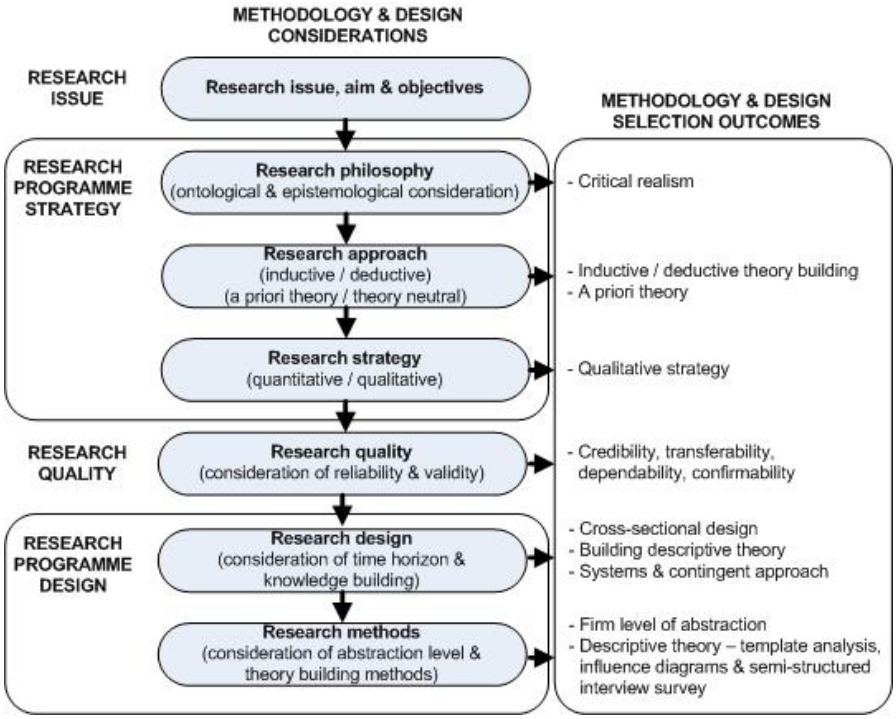


Figure 3.1: Overview of research methodology & design

3.1 Research issue, aim and objectives

An overview of the research issue addressed by this study's primary research question is provided. A research aim derived from the primary question is used to formulate the research objectives of this study. A research programme is then designed to fulfil the research objectives.

3.1.1 Research issue

Innovation outsourcing is a strategic decision involving the antecedents, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries. It is a practice that is increasingly adopted by firms worldwide and represents a step change from the traditional perception that all its innovation activity is a core function which must be well-resourced and retained wholly within its bounds. Innovation outsourcing offers many advantages which have been well documented within the literature, e.g.: shorter timescales for development; access to specialist talent; more focussed use of resources; lower costs; increased flexibility; lower development risk; a window on new technologies (Howells et al., 2008) (Piachaud, 2002) (Quinn, 2000). It is only recently that the literature has highlighted the severe consequences when innovation outsourcing fails (Ciravegna and Maielli, 2011), (Zirpoli and Becker, 2011a) (Zirpoli and Becker, 2011b). Poorly understood and executed innovation outsourcing results in an erosion of a firm's component-specific and architectural knowledge, declining sales and potential demise. Consequently, the key challenge for firms is to develop capabilities for outsourcing innovation, taking advantages of its many benefits whilst mitigating its risks.

3.1.2 Research aim & objectives

The above assessment of the research issue identifies that a firm's endeavour to outsource innovation must be supported with effective structures and routines to ensure an outcome of improved firm performance. This is summarised as the following primary research question:

Research question: How can firms successfully outsource innovation?

Innovation outsourcing has been identified as an intrinsically complex real-world phenomenon that has been adopted by firms in various industries worldwide. It comprises many aspects and cuts across multiple disciplines. A review of the extant literature identifies that much of the research has a narrow focus concentrating on a few individual elements of the phenomenon. There does not exist a study which addresses innovation outsourcing in its entirety as a firm-centric practice applicable across industries. The aim of this study is to:

Research aim: *Develop a generic holistic model to aid firms to successfully outsource innovation.*

Research sub-questions: Consideration of the research aim enables the primary research question to be decomposed in to its constituent research sub-questions:

1. What is innovation outsourcing, why is it important, and what are the key issues surrounding the domain?
2. What are the capabilities associated with successfully outsourcing innovation, and how should they be organised to realise performance?
3. How does the outcome help managers?

Research objectives: The research sub-questions are addressed by the following research objectives to fulfil the research aim and, consequently, the primary research question:

1. Undertake a state-of-the-art review to define a baseline of knowledge relating to innovation outsourcing as a management discipline.
2. Develop a validated holistic model through the identification & organisation, and refinement of innovation outsourcing capabilities for performance.

(a) Inductively develop an archetype framework for successfully outsourcing innovation.

(b) Develop a preliminary innovation outsourcing model by exploring the framework to identify the associations between capabilities and performance.

(c) Design and administer a survey to gather appropriate data with which to test the preliminary model.

(d) Analyse the results of the survey to deductively validate & refine the model.

3. Discuss the potential benefits of utilising the model to outsource innovation.

This study's research question, aim and objectives is summarised in Fig. 3.2.

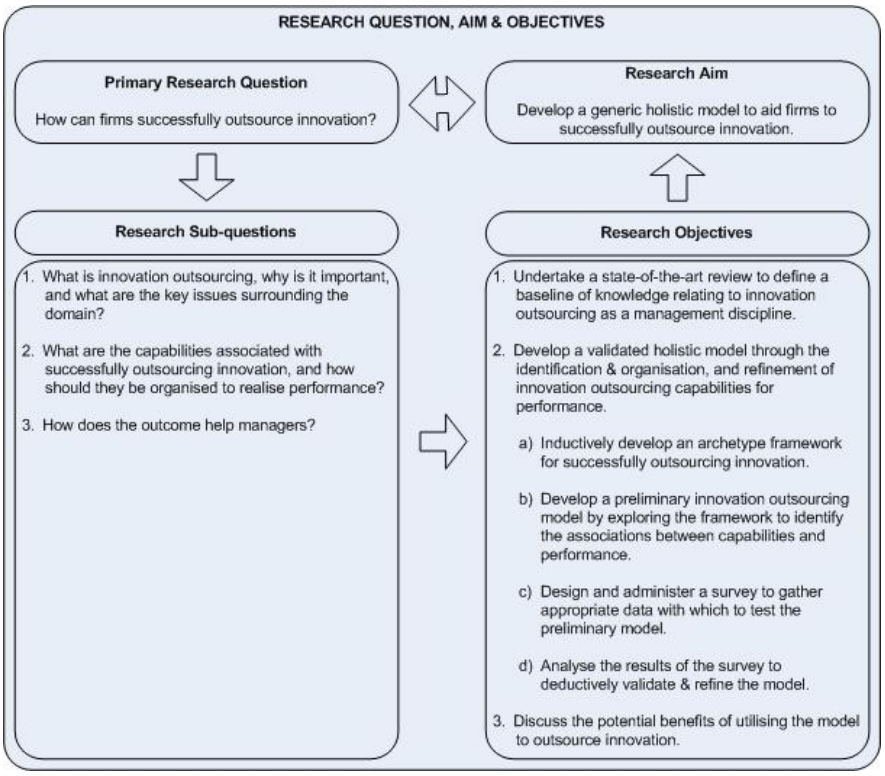


Figure 3.2: Overview of research question, aim and objectives

3.2 Research programme strategy

This study aims to identify the firm capabilities that should be adopted to effectively outsource innovation. The research programme strategy to fulfil this aim gives due consideration to its research philosophy, research approach and research strategy.

3.2.1 Research philosophy

Research philosophy forms the foundation of any research enquiry. It concerns the nature of reality, (ontology), and acquiring knowledge of that reality, (epistemology), i.e., what we can know and how we can obtain that knowledge. A study's philosophical perspective drives its research methodology and consequently it is important to carefully consider and be clear about the philosophical stance that is adopted.

Ontological consideration: There exist two main opposing positions on the nature of reality and on which research enquiry is based, the objectivist position and constructivist position. There are, however, positions that can be adopted between these two extremes.

Advocates of the objectivist position consider the social world to exist externally lending itself to being measured objectively where social phenomena exist independently of social actors and are beyond influence. This is the traditional way of conceptualising the firm, i.e., a separate entity with set structures, procedures and culture which acts on and constrains those who interact with it, e.g., employees and customers.

Advocates of the constructivist position consider reality to be socially constructed rather than being objectively determined. Social phenomena are created from the perceptions and consequent actions of actors where it is often necessary to study the details to understand the reality behind a situation. This way of conceptualising the firm emphasises that its structures, procedures and culture exist as a result of continuous social enactment by actors.

Epistemological consideration: The two extreme perspectives on acquiring knowledge from reality are positivism and interpretivism.

Positivism imitates the perspective of the natural scientist by holding the view that the social world lends itself to being measured objectively. A sharp distinction is drawn between theory and practice where the role of research is to test theory and develop laws. Typically, positivist studies initially develop a hypothesis deduced from extant theory which is expressed as a relationship between specific variables to be tested. The outcomes of hypothesis testing are examined to identify confirmation or rejection of the theory. Rejection indicates a need for modification of the theory in light of findings. After modification, the testing cycle is repeated to verify the revised theory (Robson, 2002).

The interpretivist perspective holds that the social sciences are fundamentally different to the natural sciences due to the distinctive nature of humans. Social reality has meaning for humans, i.e., they act on the basis of meanings they attribute to their acts and the acts of others (Bryman and Bell, 2011).The emphasis within studies that adopt the interpretivist stance is on the understanding and explanation of human behaviour. Such studies detail how social groups interpret the world around them, placing them within a social frame using appropriate concepts and theories.

Realism is a perspective which lies between positivism and interpretivism. It shares the view with positivism that there is a single reality that exists independently of the observer and which is socially constructed. There are two types of realism, empirical realism and critical realism. Empirical realism asserts that reality can be understood through the use of appropriate methods and is sometimes criticised for being 'superficial' because it fails to recognise the underlying mechanisms. In contrast, critical realism asserts that 'we will only be able to understand - and so change - the social world if we identify the structures at work that generate those events and discourses ... These structures are not spontaneously apparent in the observable pattern of events; they can only be identified through the practical and theoretical work of the social sciences' (Bhaskar, 1989).

Adopted stance: Adopting one ontological/epistemological position over another concerns making assumptions about how the world works. A review of the

literature has identified that there exists some aspects of innovation outsourcing, e.g., transaction economics, which display characteristics associated with an objectivist/positivist position, whilst there are others, e.g., culture, which display characteristics associated with a constructivist/interpretivist position. This is supported by the outcome of the survey of philosophical stances adopted by literature which displays that 41% of studies adopt a positivist stance and a significant 21% adopt an interpretivist stance.

This research, however, is not concerned with the study of individual characteristics of innovation outsourcing, but with it as a firm-centric discipline driven by management decisions to improve innovation performance. Whilst an approximately equal number of studies adopt a realist stance, i.e., 38%, as a positivist stance within the literature, the balance changes when two or more stages of the innovation outsourcing process are considered, in which case 56% of studies adopt a realist stance. This study, in keeping with the real-world nature of innovation outsourcing as a management discipline, adopts a critical realist philosophical stance.

3.2.2 Research approach

Research approach concerns drawing out the nature of the relationship between theory and research, i.e., identifying the role of theory within a study. The term 'theory' within this study is used in its broadest sense to mean an explanation of observed regularities, for example, why firms tend to outsource some innovation activity, whilst outsourcing others. This is in contrast to the notion of 'grand theory' (Merton, 1967), e.g., symbolic interactionism, which operates in a broader domain due to its higher level of abstraction, but is difficult to relate to the real world.

The relationship between theory and research can be described as either deductive or inductive. Deductive theory involves deducing a hypothesis from extant theory which is then empirically scrutinised, i.e., theory → hypothesis → data collection → findings → hypothesis confirmation/rejection → revision of theory. In contrast, inductive theory involves developing theory from research by

drawing out generalisable findings from observations, i.e., data collection → findings → theory. In reality, the distinction between deductive theory and inductive theory is not clear cut. Deductive theory involves some degree of induction and inductive theory involves some degree of deduction.

Adopted approach: The literature identifies that there exists a significant number of disparate studies concerning various aspects of innovation outsourcing. There does not, however, exist a study which draws together the differing aspects in to a unified view. The purpose of this study lends itself to a research approach of theory-building that uses both inductive and deductive methods. Reflecting the disparate nature of innovation outsourcing studies, an analysis of the approach adopted by the various studies identifies that there isn't any clear preference; whilst the majority of the innovation literature, 50%, adopts an inductive approach, a significant 38% adopts a deductive approach.

The role of theory as a starting point presents two options. An *a priori* theory approach to frame a study is proposed by (Yin, 2009), whilst (Eisenhardt, 1989) proposes a 'theory-neutral' approach where new variables and explanations are discovered. The review of literature identifies that there exists *a priori* awareness of innovation outsourcing amongst both academics and practitioners. Consequently, an *a priori* theory approach is adopted by this study as a starting point because where there exists *a priori* awareness of the theory, objectivity and the case for a 'theory-neutral' approach is diminished.

3.2.3 Research strategy

Research strategy is the 'general approach taken in an enquiry' (Robson, 2002), which should reflect and be appropriate to the research questions and objectives of the study. A useful, although ambiguous, distinction between differing research strategies is the notion of qualitative and quantitative research (Bryman and Bell, 2011).

Quantitative research emphasises quantification using numbers when collecting and analysing data. It typically, adopts a deductive approach to the relationship between theory and research, is positivist in its routines for knowledge gen-

eration and views social reality as external and objective. In contrast, qualitative research emphasises words rather than numbers when collecting and analysing data. It typically, adopts an inductive approach, generating theory from observation, explaining how individuals interpret the social world, viewing social reality as emergent.

Adopted strategy: The novelty of innovation outsourcing and its emphasis as a complex management discipline characterises it as an emergent domain that lends itself more to a qualitative research strategy than one that is quantitative.

3.3 Research quality

Research quality is concerned with limiting the risk of erroneous findings within research. Common criteria for evaluating research are reliability and validity. They are fundamental considerations which are dependent on the research situation and should be considered integral to the research design.

Reliability: Reliability concerns whether the results of a study are repeatable. The types of reliability are:

1. External reliability - this is the degree to which a study can be replicated, i.e., whether a study's measures will produce the same results on other occasions.

2. Internal reliability - refers to whether the same observations made within a study would be made by other observers.

Closely associated with reliability is the notion of replicability. Researchers sometimes choose to replicate the findings of others which occurs, for example, when there is new conflicting evidence. In order for a study to be replicable, procedures must be spelt out in great detail.

Validity: Validity is concerned with the integrity of conclusions, i.e., whether the outcomes drawn from a study are what they appear to be. The main types of validity are:

1. Construct validity - refers to whether a measure used to denote a concept truly reflects that concept. The assessment of measurement validity presupposes that a measure is reliable.

2. Internal validity - is concerned with the notion of causality, i.e., whether a conclusion that states a causal relationship between two variables is reasonable. If it is stated that variable x causes y, can it be certain that x is the cause and not something else.

3. External validity - refers to generalisability and whether the results of a study can be applied beyond the specific context of the study.

Qualitative studies: A criticism of the terms 'reliability' and 'validity' are that, even though they are applied to qualitative studies, they are inherently quantitative research terms because they are concerned with measures (Bryman and Bell, 2011). Alternative terms have been proposed by some researchers which specifically address quality within qualitative research. The term 'trustworthiness' has been proposed as a term for a good qualitative study (Lincoln and Guba, 1985) comprising aspects which parallel terms used in quantitative studies.

1. Credibility - refers to how believable are the findings of a study, similar to internal validity.

2. Transferability - refers to the extent to which findings are applicable to other contexts, similar to external validity.

3. Dependability - refers to whether a study's findings are applicable at other times, similar to reliability.

4. Confirmability - refers to the degree to which a researcher's values have been allowed to intrude in to a study, similar to objectivity.

In addition, the quality of qualitative research can be determined by the extent to which potential users can be confident in the knowledge generated and its relevance to practitioners. Due to the novelty of innovation outsourcing management there does not exist a model within the literature against which to validate results. In this circumstance the following stance is adopted, "... if all else fails we have to say 'this is how the concept is defined and these measures, on the face of it, seem to cover the concept', and to give the measure to other people to see what they think" (de Vaus, 2001)

In keeping with the qualitative nature of this study's research strategy the above terms are adopted. Consideration of research quality is provided and discussed within each phase of this study's research design.

3.4 Research programme design

Research programme design refers to the general plan of how a study's research objectives are to be achieved. In formulating the plan due consideration is given to: the general purpose of the research; research design; research methods and time horizon

3.4.1 General purpose of research

Research fulfils its objective of contributing to knowledge by one or more of three means, by exploring, describing or explaining situations (Robson, 2002). Exploratory studies seek to find out what is happening within a subject domain, to ask questions and assess phenomena from differing perspectives to gain new insights. Descriptive studies aim to portray an accurate profile of a situation or event so it they can be evaluated for synthesising new ideas. Often a descriptive study is a precursor to an explanation. Explanatory studies tend to study a situation to explain the relationship, such as cause and effect, between variables. In general, due to the nature of the data, exploratory research is largely qualitative, whilst explanatory and descriptive research may be both qualitative and quantitative.

Due to the novelty of innovation outsourcing, the primary objective of this study is exploratory, aiming to explore management practices to enable innovation outsourcing. In addition, there is also a descriptive element to this study which aims to describe management action to enhance innovation outsourcing capability.

3.4.2 Time horizon

The time horizon of research relates to whether the aim is to study phenomena *at* a particular time, i.e., cross-sectional, or study phenomena *over* a period of time, i.e., longitudinal. A cross-sectional design provides a 'snapshot' of phenomena. It is used to describe the incidence of business phenomena or relationship between management factors at a given time. In contrast, a longitudinal design is primarily used to map change in business and management research. It provides insight in to the time order of variables where, typically, a sample is surveyed and then surveyed again after a given period.

This study's objective of exploring innovation outsourcing management practices is best achieved using a cross-sectional research design. A longitudinal approach to this study is disregarded because it is not the objective of this study to explore the changing development of innovation outsourcing management practices.

3.4.3 Research design

Research design concerns the approach and methods a researcher uses to address the primary research question. It is guided by the research aim and objectives, research philosophy, the extent of existing knowledge, and available resources including time (Saunders et al., 2009). Examples of research design include survey, case study, grounded theory and action research.

This study's aim is to develop knowledge to aid firms when they outsource innovation, a complex multi-variable phenomenon which cuts across multiple disciplines. Any research design that effectively addresses this aim must consider two key characteristics, building knowledge and consideration of the broad range of factors associated with innovation outsourcing.

3.4.3.1 Building knowledge

The review of literature identifies innovation outsourcing as a relatively new concept which has attracted a great deal of diverse attention over a short period of time. Due to its relative novelty with an existing but limited body of knowledge this study's aim and objectives lend themselves to a research design approach of theory-building that uses both inductive and deductive methods.

Knowledge is variously defined as 'justified true belief', 'a dynamic human process of justifying personal belief toward the "truth"' (Nonaka and Takeuchi, 1995) and 'facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject' (Oxford Dictionaries, 2011). Knowledge as justified theory, (i.e., 'a statement of concepts and their interrelationships that shows how and/or why a phenomenon occurs' (Gioia and Pitre, 1990)), and practice emphasises the need to adopt a robust approach to developing innovation outsourcing decision-making theory which has both originality and utility (Corley and Gioia, 2011).

Building descriptive theory: Building original descriptive theory in management research is a process comprising inductive and deductive stages. The three steps involved in the inductive stage are observation, categorisation of attributes and definition of relationships (Christensen, 2006).

The first step, observation, forms the foundation of theory building and involves the observation of phenomena and their careful description and measurement. Constructs are often developed to aid understanding of the essence of the phenomena. The second step, classification, involves classifying the phenomena into categories which, typically, are defined by the attributes of the phenomena. Categorisation enables simplification and organisation of the phenomena to highlight possible relationships between phenomena and outcomes. Such categorisation schemes are often referred to as frameworks or typologies. The third step, definition of relationships, involves exploration of the association between the attributes of the phenomena and outcomes. The associations make explicit the differences in attributes and differences in the magnitude of attributes correlated to outcomes. The result at the end of the three steps of inductive stage of

theory building is referred to as a model.

The deductive stage of building descriptive theory involves testing the hypotheses that were inductively formulated. This is done by exploring whether the correlations between attributes and outcomes identified in the inductive stage also exist in a different set of data. Where the attributes of phenomena correlate to outcomes as predicted, the theory is confirmed under the observed circumstances.

When the attributes of phenomena do not correlate to outcomes as predicted, i.e. anomalies, there arises opportunity to improve theory. The three steps of the inductive stage of the theory building process, (i.e. observation, categorisation and definition of relationships), are reviewed to seek explanation of the anomaly. This is achieved by defining the phenomena more precisely or categorising the data better.

3.4.3.2 Holistic innovation outsourcing

The holistic aspect of this study's research aim and objectives requires consideration of the broad range of factors associated with innovation outsourcing. The review of literature has identified the narrow focus of the vast majority of studies which are concerned only with one or a few aspects of outsourcing innovation, for example (Roy and Sivakumar, 2011) is concerned only with aspects of intellectual property rights of firms outsourcing innovation. There does not exist a study which considers a holistic approach to innovation outsourcing. This is addressed by adopting an open systems and contingent approach.

Systems approach: Innovation outsourcing requires the careful management of organisational, technology and nuanced behavioural systems. The systems theory approach to management is an evolution of the classical and human relations approaches to management (Cole and Kelly, 2011). The classical approach to management (Fayol, 1949) (Taylor, 1911) considers the organisation in terms of its structure and purpose, assuming rational and logical behaviour. There is an emphasis on the technical aspects of organising people and activities, (e.g., division of work and hierarchy of authority), to improve and maintain productivity. The human relations approach to management views peoples needs, (e.g., psychological and motivational), as the key factor for achieving organisational

effectiveness. Organisations are not perceived as tools to achieve a purpose, but as social systems that are organised to survive. The systems approach to management view organisations as complex systems of people, tasks and technology, which interact intimately with their environment. Consequently, organisations evolve as a result of interacting and reacting to the environment, adapting and changing to improve performance through structure and process.

The holistic consideration of innovation outsourcing is addressed by adopting an open systems approach. The innovation outsourcing function of the firm is considered as a set of connected interrelated elements, (e.g., decisions and activities), to form a system, possessing properties as a whole rather than its constituents. It receives inputs from the firm environment, (e.g., firm strategy, people and ideas) which are transformed in to outputs, (e.g., improved firm performance and innovations), that are released back into the environment as outputs. A key characteristic of open systems is their interdependence with the environment which can fluctuate between stability and turbulence. Boundaries and their management are an important aspect of an open system because there can be several which are not always visible, (e.g., legal and social boundaries). The outsourcing of innovation as an 'open' form of the innovation function where its boundaries are permeable to the inflow and outflow of information and innovation activity. In contrast, the traditional perception of a firm's innovation function is of a 'closed' system, i.e., a core competency that must be well-resourced and retained within the bounds of the firm. Open systems are also adaptive because they have the ability, via a closed feedback loop where information is fed back to inputs, to monitor and regulate their performance. It is able to respond to changes in its environment by modifying its behaviour.

Contingent approach: Arising from open systems theory is a pragmatic approach to management which holds that there is no single theoretical approach for managing an organisation. A mix or portfolio of theoretical approaches is necessary to meet the needs of the organisation that are 'contingent' on the internal and external environment during a particular period. Contingency theory states that there isn't a single best way to organise a firm for all circumstances. Managerial decisions, (e.g., regarding firm structure, process and resource allocation),

for effective firm performance are dependent on the nature of the environment in which the organisation operates.

Innovation outsourcing is identified from the literature as a complex, multi-disciplined multi-variable phenomenon where management are often required to make decisions with vague information. A contingency approach, using contingency theory (Lawrence and Lorsch, 1967) (Burns and Stalker, 1961), is used to reflect that there is no one best way to manage innovation outsourcing and that it must be dependent on the contingencies of the situation.

3.4.4 Research methods

Research methods concern the data collection techniques and analysis procedures that are to be used to fulfil the qualitative inductive/deductive theory building research design identified for this study's research aim and objectives. Research studies can use one or more research methods such as questionnaires, structured interviews and structured observation. Multiple methods are advocated if they enable the research question to be better addressed or they enhance the credibility or transferability of the study's findings (Tashakkori and Teddlie, 2003). A multi-method approach through theory-building is used to explore the process, key practices and associated factors which influence a firm's ability to outsource innovation effectively.

Level of Abstraction: Innovation outsourcing has implications for nations and industry sectors but ultimately it is a choice that lays within the firm, in corporate policy, not just business strategy, as it modifies the firm's boundaries as a legal entity and generally involves top management decision makers' (Quelin and Duhamel, 2003). Consequently, the level of analysis adopted by this study is of the firm.

3.5 Research programme methodology

This research study is divided into two stages representing the inductive and deductive elements of building descriptive theory. An overview of the methods

used within each of the inductive and deductive stages is provided prior to detailed descriptions of their selection and use.

3.5.1 Stage 1 - descriptive theory-building - induction

Induction is used in the first stage of exploring the process, key practices and associated factors which influence a firm's ability to outsource innovation effectively. It involves coding data relating to innovation outsourcing to develop a generic holistic framework. A model is then developed by exploring the framework to identify the associations between innovation outsourcing process and key practices with performance. This is illustrated below in Fig. 3.3.

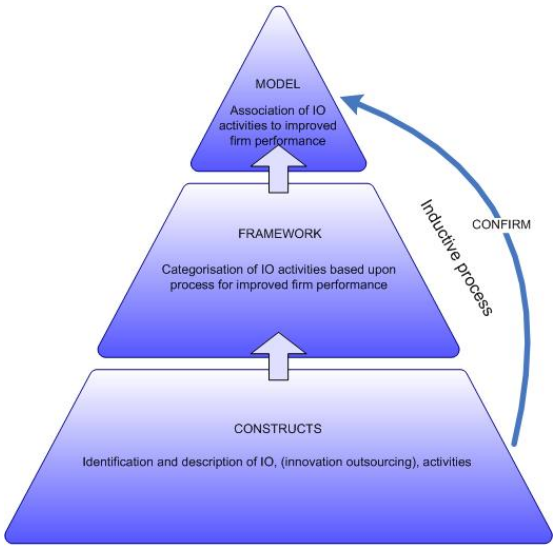


Figure 3.3: Inductively building descriptive innovation outsourcing theory

3.5.1.1 Framework development overview

Template analysis is used to define a template of innovation outsourcing themes from a literature data set of 248 research articles. A framework for successfully outsourcing innovation is developed from the template by interpretng it as an

innovation outsourcing archetype. The framework comprises the process, key practices and factors related to successfully outsourcing innovation.

3.5.1.2 Model development and visualisation overview

Model development overview: Influence diagrams are used to explore and identify the associations between innovation outsourcing activities and firm performance. The model is represented as propositions which relate innovation outsourcing process and capabilities to firm performance.

Model visualisation overview: Soft systems methodology is used to develop rich pictures of the model. The rich pictures serve two purposes. Firstly, to aid visualisation of the model. Secondly, they also enable enquiry of complex real-world innovation outsourcing situations in order to gain insights. This is particularly valuable within the deductive stage of descriptive innovation outsourcing theory-building.

3.5.2 Stage 2 - descriptive theory-building - deduction

The initial stage of this study inductively develops an *á* priori model of process and practice relating to the phenomenon of innovation outsourcing. The second, deductive, stage involves testing the model to explore whether the correlations between attributes and outcomes identified in the inductive stage also exist in a different set of data. Theory relating to innovation outsourcing practices and process are confirmed where attributes correlate to outcomes as predicted. Where the examination of innovation outsourcing practices and process identify that attributes do not correlate there is an opportunity to enhance theory. The attributes of innovation outsourcing phenomena are reviewed to identify whether better definition or categorisation can explain the anomaly. This is illustrated below in Fig. 3.4.

3.5.2.1 Model testing - data collection overview

A semi-structured interview survey is used to collect the data set with which to test the *á* priori model of innovation outsourcing. A methodical approach is

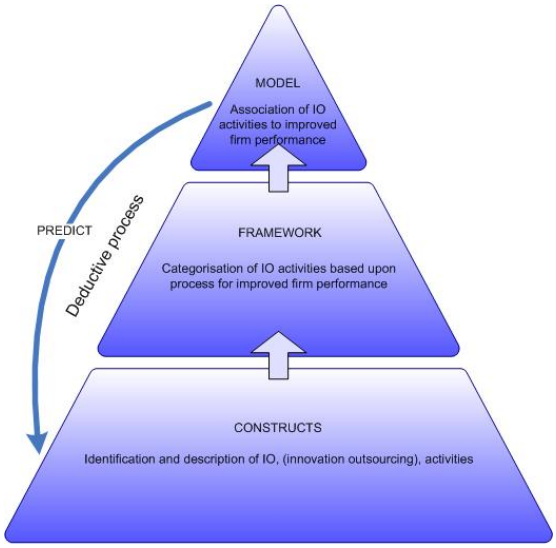


Figure 3.4: Deductively building descriptive innovation outsourcing theory

adopted for the survey's design and execution to aid research quality (Kvale and Brinkmann, 2009). In particular, an interview survey instrument is developed comprising rich pictures to overcome the challenge of eliciting and capturing as much detailed and nuanced information as possible during interviews.

3.5.2.2 Model testing - data analysis overview

Pattern matching and explanation building are used to analyse the interview data and explore the correlations between innovation outsourcing activities & process and firm performance. The outcome is an innovation outsourcing model correlating to improved firm performance.

3.6 Framework development method

Potential techniques for inductively developing the innovation outsourcing framework are reviewed. The technique deemed most appropriate is selected and its use described.

3.6.1 Potential techniques for framework development

There exist various techniques for inductively developing an *á* priori innovation outsourcing framework, e.g., analytic induction, grounded theory, framework analysis, etc. A review of some of the main inductive techniques is provided below.

3.6.1.1 Analytic induction

Analytic induction is a process for analysing data to build universal explanations of phenomena (Znaniecki, 1934). An initial description of a phenomenon, (i.e., explandum), and explanatory factors, (i.e., explanans) are developed as a hypothesis. Data are collected and compared, (i.e., cases), with the hypothesis to identify whether it is supported or contradicted. If the case is inconsistent with the hypothesis, either or both the description is revised and/or the explanation is reformulated to account for the inconsistency. Continuous iterations of this process are undertaken with a diverse range of cases until inconsistent cases can no longer be pragmatically pursued.

The primary objective of analytic induction is causal explanation where the aim is to maintain universal relationships between factors throughout the process. It is a rigorous method of analysis because encountering only a single occurrence that is inconsistent with the hypothesis requires further data to be collected or the hypothesis to be reformulated. Analytic induction also requires a sample of data that is sufficiently large and diverse to have tested the theory.

3.6.1.2 Grounded theory

Grounded theory (Glaser and Strauss, 1967) (Strauss and Corbin, 1990) is an inductive/deductive process of theory building. It is has been defined as 'theory that was derived from data, systematically gathered and analyzed through the research process. In this method, data collection, analysis, and eventual theory stand in close relationship to one another' (Corbin and Strauss, 2008). It differs from other forms of induction by not starting with an initial theoretical framework. Instead, theory is developed from data generated by observations and then tested by further observations which may confirm or contradict predictions. The

tools of grounded theory are theoretical sampling, open/axial/selective coding, theoretical saturation and constant comparison. The outputs of grounded theory are, concepts (i.e., labels given to discrete phenomena), categories (a concept applied to real-world phenomena), properties (i.e., attributes of a category), hypotheses (i.e., possible relationships between concepts), and theory (i.e., a set of well developed categories that are systematically related to form a framework to explain a phenomenon). It is important to understand that grounded theory is not a simple mechanistic process but a creative process which requires considerable experience and a good understanding of the domain being studied.

3.6.1.3 Framework analysis

Framework analysis is an inductive approach developed at the UK National Centre for Social Research. It comprises five steps: familiarization, identifying a thematic framework, indexing, charting, and mapping & interpretation (Ritchie and Spencer, 1994). Data are categorised to identify a set of main themes and related subtopics which are structured in to a hierarchical framework. Once a main theme is assessed to be comprehensive it is analysed within a matrix of cases and subtopics. The matrices are then examined for patterns.

3.6.1.4 Template analysis

Template analysis (King, 2004) is a process of induction involving the development of an initial template of themes derived from a small section of data. The initial template is then used to analyse the complete data set. As the data set is analysed the template is modified to add, redefine or remove existing themes until the data set is exhausted.

3.6.2 Framework technique considerations and selection

The process of induction represents the foundation of theory building requiring an appropriate and robust technique. The considerations and selection of technique are detailed below.

Research quality: Credibility (i.e., internal validity), transferability (i.e., external validity) and dependability (i.e., reliability) are important considerations in the choice of induction procedure. Credibility concerns, firstly, the extent to which conclusions are unambiguously drawn from premises and, secondly, the extent to which other plausible explanations linking phenomena to outcomes of interest can be ruled out. Transferability concerns the extent to which a relationship observe between phenomena and outcomes in one context can be trusted to apply in other contexts (Christensen, 2006). Credibility is established by examining phenomena through the lens of as many different disciplines and research tools as possible whilst transferability is established by examining phenomena in as many different settings as possible, i.e., large-sample and diverse-sample data enhances a study's credibility and transferability.

Awareness of phenomenon: The role of the awareness of phenomena presents two options for the selection of an appropriate procedure for induction, an *á* priori awareness approach or a 'neutral' awareness approach. This study adopts an *á* priori awareness approach because there exists *á* priori awareness of the innovation outsourcing phenomenon within the body of literature that is used as data for this study. Consequently, the case for using grounded theory or analytic induction as a procedure for theory-building is diminished.

Flexibility: A criticism of framework analysis is the inflexibility of the procedure after the thematic framework has been identified. In contrast, template analysis allows flexibility in the definition of themes throughout the process enabling emergent themes and constructs to be developed.

Justification of template analysis: Selection of template analysis is justified due to its use with a variety of methodological and epistemological positions including realism, accommodation of *á* priori awareness of the innovation outsourcing phenomenon and its flexibility in the definition of themes throughout the process enabling emergent themes and constructs to be developed.

3.6.3 Template analysis - outline and use

The template analysis technique is summarised in the following steps:

1. Definition of *á* priori themes.
2. Reading and familiarisation of the data set.
3. Coding and development of template including quality checks.
4. Review and interpretation of final template.

3.6.3.1 Definition of a priori themes

Themes refer to the features of particular accounts that characterise perceptions and/or experiences that are relevant to a research study. Coding refers to the process of identifying themes in accounts and attaching labels to them (King, 2004). Themes are viewed as tools which aid the production of an account of the data. The following pragmatic intent was kept in mind throughout the process of template analysis, 'if I code the text in this way, is it likely to help me build my understanding of the data' (King, 2012).

The definition of *á* priori themes must be done with care to aid the credibility of the research, (i.e., how believable are the findings of a study, similar to internal validity). The *á* priori themes are defined in relation to this study's research objective of aiding firms to outsource innovation and their number was restricted as far as possible. Also, during initial coding it was borne in mind that the *á* priori themes are tentative and should be redefined or removed as appropriate. These steps ensured that there was not a blinkering effect during the analysis where material could be missed due to too much focus on trying to neatly fit data to a pre-determined outcome.

The definition of innovation outsourcing synthesised in a previous chapter is used to identify the *á* priori themes. Innovation outsourcing is defined as 'a strategic decision involving the antecedents, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries'. Three themes are identified from the definition of innovation outsourcing to serve as *á* priori themes: 'Antecedents',

'Processes', and 'Implications'. These themes are deemed sufficient to initially address the research objective of this study whilst minimising their number. This is undertaken to prevent the pre-judgement of outcomes and to aid credibility of the study.

3.6.3.2 Justification of data set

Prior to coding and development of the template, it is necessary to identify and source the data that is to be used.

The identification of a data set to use for inductively building a generic holistic model of innovation outsourcing offers two choices, to collect primary data, (i.e., new data specifically for the purpose using, for example, interviews, observations or questionnaires), or to use secondary data, (i.e., data collected for some other purpose which may also be appropriate for this study such as documents or surveys). Selection of the type of data to use is dependent on an evaluation to ascertain whether: the study's research aim and objectives are sufficiently addressed; the benefits of using the data outweigh their disadvantages, and there is sufficient access (Saunders et al., 2009).

Secondary data in the form of literature identified previously for the review of literature is used for inductively building a generic holistic model of innovation outsourcing. The rationale for doing so, in terms of its overall suitability and specific suitability, are detailed below.

Overall suitability: A principal concern when selecting a data set is that it must be appropriate for the needs of the research study, i.e., able to address the research question, aim and objectives. Primary data has the advantage that it is collected for the specific purpose of addressing a study's research aim and objectives. It is not, however, always pragmatic to use primary data when there exist alternatives and, especially, where a research study is constrained by available resources, (i.e., time and financial), and access to sources of primary data, (e.g., organisations and personnel). In such circumstances, it is appropriate to use secondary data sources. The use of secondary data for this study is justified in terms of its overall scale, diversity, speed, quality and permanance.

Scale & diversity To fulfil the aim of building a generic holistic model of innovation outsourcing requires a large and diverse range of data. The review of literature identifies a significant and diverse number of innovation outsourcing studies over a significant period of time. To collect a similar scale and diversity of primary data using, for example, interviews or observations would necessitate a scale of resources not available to this study. Initial investigations also indicated that access to organisations and personnel from which to collect the scale and diversity of primary data necessary for this study may have been difficult.

Speed & quality The use of secondary data in the form of literature provides quick access to a large amount of data relative to collecting primary data through interviews or observations. The speed of access to secondary data in the form of literature provides more time to consider the substantive issues concerning this study. It also allows more time to analyse and interpret the data which would otherwise have been spent on data collection. Due to the potential difficulty concerning access to organisations and personnel from which to collect the scale and diversity of primary data necessary for this study, the quality of data from literature is likely to be higher (Stewart and Kamins, 1993).

Permanance Secondary data in the form of literature provides a data source that is permanent and available in a form that can be easily checked by others (Denscombe, 2007). This degree of transparency of literature as a secondary data source aids this study's confirmability.

Specific suitability: Subsequent to an overall decision to use secondary data, it is necessary to justify the use of a specific data set. This is done with due consideration of the data set's construct validity, credibility and dependability for the intended purpose.

Secondary data will have previously been collected for a specific purpose, consequently, care needs to be taken to ensure that it is appropriate to the purpose of this study. It has the advantage over primary data that because it already exists, it can be evaluated prior to use (Stewart and Kamins, 1993).

Intended purpose An important criteria for any data is its suitability for the purpose intended, i.e., measurement or construct validity. This refers to whether the data will provide the information necessary for addressing the aim and objectives of the study or whether it will result in invalid results (Kervin, 1999). Whilst there does not exist a clear method for evaluating secondary data for measurement validity, a common way is to examine how other researchers have managed similar scenarios in similar contexts (Saunders et al., 2009). Support for using literature to inductively develop a conceptual model of factors influencing an organisation's ability to manage innovation is provided by (Smith et al., 2008).

Coverage Another suitability criterion for secondary data is coverage, i.e., ensuring that the data contains the information necessary for addressing the aim and objectives of the study whilst ensuring that unwanted data can and are excluded (Saunders et al., 2009). How literature is sourced and collected influences this study's credibility, (i.e., how believable are the findings of a study, similar to internal validity), dependability, (i.e., whether a study's findings are applicable at other times, similar to reliability), and confirmability, (i.e., the degree to which a researcher's values have been allowed to intrude in to a study, similar to objectivity).

The data to be used for building a generic holistic model of innovation outsourcing are obtained using a structured methodological approach of data collection and data categorisation described in the review of literature. Searches are undertaken using two leading databases of literature within the business and management domains. Searches contain the terms 'outsourcing and (R&D or innovation)' and criteria specified to restrict the search to journal articles, scholarly journals or academic journals and those that are peer reviewed. Each paper is read and studied in detail before categorising them according to particular foci where innovation outsourcing is treated as a discipline used by management to make informed decisions based on a good understanding of the enterprise and its external environment.

The data set as literature is diverse, possessing low 'specificity', i.e. it is not specific to particular authors, countries, industries, firms, research methods or disciplines. This minimises any measurement bias within the data set. Where

data from two or more papers suggest similar conclusions there can be greater confidence that the data on which the conclusions of this study are based are not distorted.

The nature of the data set and process of structured data collection ensures that the literature possesses the necessary coverage for this study whilst excluding unnecessary information. The authority or reputation of the source is easily determined by reviewing the list of journals from which the papers are derived. This, together with the process enhances the degree of credibility, reliability and dependability of this study.

3.6.3.3 Familiarisation of data set

The structured process of data collection summarised above and detailed in the review of literature encompasses and ensures a close familiarisation with the data set. Familiarisation of the data set enables better understanding of the data and consequently better coding of the template enhancing this study's credibility.

3.6.3.4 Coding and development of template

Initially a manual procedure was adopted for coding each paper of the literature data set. A paper was read from beginning to end without interruption. The same paper was read again and sections of interest were highlighted with annotations. Some considerations when highlighting section of interest were (Lofland et al., 2004) (Bryman and Bell, 2011): what does this item of data represent?; what is happening here?; what are people doing?; what is occurring?. It quickly became apparent that due to the large number of papers that formed the literature data set, that it was necessary to consider the use of computer-assisted qualitative data analysis software to aid management of the coding process.

CAQDAS: Computer-assisted qualitative data analysis software, (CAQDAS), is used to help with the manual and administrative aspects of coding and template development. In particular, it helps with marking sequences of text with codes and retrieving all sequences of text relating to a code. CAQDAS does not help with decisions about coding of textual data or interpretation of findings.

Decision to use CAQDAS Using CAQDAS makes the coding and retrieval process more efficient. In addition to improved efficiency, it has been suggested that its use enhances the transparency of the process for qualitative data analysis as it requires the researcher to be more explicit about their analysis and helps to think about the development of codes as 'trees' (Bryman and Bell, 2011). There isn't, however, universal agreement about the benefits of CAQDAS. The primary concern is that its use exaggerates the code-and-retrieve process resulting in the over-fragmentation of textual data and loss of context (Bryman and Bell, 2011). CAQDAS also requires additional time to become familiar with new software.

The inductive stage of theory-building through template analysis represents the foundation of this study requiring an appropriately robust procedure. It was deemed that the scale of the data set in terms of the number of papers to be analysed necessitated the use of CAQDAS. Its use would help with the management of the potentially large number of sections of text and aid the transparency of the coding process. Care was taken throughout the coding process to ensure that there was not over-fragmentation of textual data.

Selection of CAQDAS Three CAQDAS packages are considered for use to aid this research study; NVivo v7, Atlas.ti v6.2, and Weft QDA v1.0.1. NVivo and Atlas/ti are commercial software packages whilst Weft is available free under a public domain licence. Weft is selected as the CAQDAS package most appropriate for this study. Its selection is based on its ease of access, ease of use and fit for purpose.

Weft can be freely downloaded from the 'pressure.to' website. It is quickly and easily installed on computer hardware with modest requirements and fully supported on various versions of Microsoft Windows. Weft has a simple user interface that is easy to understand and use because it is based on a core set of 'code and review' features. Weft fulfils the needs of this study by enabling the management of the qualitative analysis of the data set efficiently through the simple creation of a project file, import of documents, creation of categories and development of the template.

The commercial CAQDAS packages NVivo v7 and Atlas.ti v6.2 were disregarded in favour of Weft because they were more difficult to access, had multiple complex features and tools (e.g., fuzzy matching, visual theory modelling etc.), designed for a range of studies that were not required for this research study. In addition, they had more complex user interfaces which may have required more time to become familiar with the software.

Coding using Weft: Development of the template after starting Weft QDA involves, creating a new project; importing documents; creating initial categories; coding text, and; reviewing codes.

Project creation A new project is created in Weft using the file menu. A project is a collection of related text documents in a single file together with observations, insights and notes relating to those documents (Fenton, 2006).

Importing documents The papers comprising the literature data set are each labelled with file names that reflect the year the paper was published, the lead author and the title of the paper to ensure that they are quickly and easily identifiable. The literature data set are imported into the project as individual papers in pdf format.

Initial category creation The initial template *á* priori themes: 'Antecedents', 'Processes', and 'Implications', are created as new categories beneath the empty category tree.

Coding text Starting with the most recent, each paper is opened within Weft and read from beginning to end without interruption. The coding process is started with the most recent paper to mitigate risks to research credibility due to historical data. The same paper was read again and pertinent sections of text identified. A section of text is marked and assigned to one of the three categories, antecedents, processes and implications where appropriate. Where a section of text that is deemed pertinent does not fit one of the three initial categories, a

new category is created. This procedure is repeated for each paper within the literature data set.

After all papers have been coded, the categories and all sections of coded text for each category are reviewed and reflected on to determine whether categories should be renamed or sections of text moved or removed. The initial wave of coding and categorisation is concluded once it is judged that the template at this stage suitably addresses the research question whilst reflecting the data set.

The second and subsequent waves of category definition and coding involves reviewing the sections of coded text for each category to determine whether further categories can be defined and applied to them. The procedure for coding text within a category is similar to coding from a source document, i.e., define and/or select the category to be coded; highlight the section of text within the previously coded category text and assign it to the category. After all the initially coded text has been 'coded on', the template is again reviewed and reflected on to identify whether categories should be renamed or sections of text moved or removed.

Waves of category definition and coding are undertaken to build and refine the template until it is judged further 'coding on' will not illuminate the data set to enlighten the research question. At this 'coding on' is halted to mark the definition of the final template.

3.6.3.5 Review and interpretation

Review and interpretation of the final innovation outsourcing template concerns developing insight from the template. The template itself is not the end product of the analysis, but a tool to produce an interpretation of the data, using its richness to help address the research question.

Innovation outsourcing themes are listed to provide an overview and are used to reveal interesting patterns that may warrant attention. The interpretation of themes within the template requires making judgements about the salience of themes that address innovation outsourcing phenomena and the research question. Prioritising themes helps avoid being overwhelmed by the detail. Prioritisation of innovation outsourcing themes is not done on the basis of those that

are most common across the data, but on those that provide insight and help address the research question. Care is also taken not to prioritise too early when interpreting data as the emergence of strong tangential themes may help to add context to the main focus of the phenomenon (King, 2012).

3.7 Model development method

This section identifies and reviews potential techniques for inductively developing an innovation outsourcing model. The technique deemed most appropriate is selected and its use described.

3.7.1 Potential techniques for model development

There exist various techniques for inductively developing an *á* priori innovation outsourcing model through the exploration and identification of associations between innovation outsourcing activities and firm performance. Methods for modelling relationships between concepts include cognitive mapping (Eden, 1988) (Eden and Ackermann, 2000) (Ackermann and Eden, 2001) and influence diagrams (Howard and Matheson, 2005) (Howard, 1989). A review of some of the main inductive techniques is provided below.

3.7.1.1 Cognitive maps:

are a qualitative graphical representation of an influence network between concepts. An influence is a causality relation from one concept to another (Chauvin et al., 2009). Cognitive maps are commonly used as a visual device for analysing and communicating complex systems. They have found application in a variety of disciplines including politics (Levi and Tetlock, 1980) and business management (Eden et al., 1983).

Cognitive maps are displayed as oriented graphs. Concepts form the nodes of the graph and are, typically, described textually. Concepts are linked using an arc. The direction of influence is displayed via an arrow and the effect of influence is displayed as either positive or negative.

Individuals have differing perspectives on reality, they have differing views, interpret the world in various ways, and form differing conclusions. Cognitive maps, drawing on personal construct theory (Kelly, 1955), are used to capture individual perspectives and reflectively analyse situations towards a solution (Eden, 1992).

3.7.1.2 Influence diagrams:

provide a simplified understanding of complex relationships. They are a qualitative graphical representation of dependencies that exist between events and decisions which lead to an outcome given a particular course of action. Nodes are represented as either events or decisions and arrowed arcs between the nodes represent the direction of influence. Influence diagrams have found utility in various disciplines which include medical diagnosis (de Braganca Pereira and Barlow, 1990) and manufacturing management (Er and Lezki, 2012).

3.7.2 Model technique considerations and selection

The use of influence diagrams is selected as a means to explore and identify the associations between innovation outsourcing activities and firm performance. The rationale for doing so is based on their appropriateness for the specific task.

Whilst the syntax of cognitive mapping and influence diagrams may appear to be similar, there are differences between the two techniques relating to the degree of formality and objectivity. As a modelling technique cognitive mapping is used to capture and portray a manager's ideas, beliefs and attitudes with respect to a particular issue and describe how they inter-relate. It is not supposed to be a model of an objective reality, consequently, it can never be shown to be correct or incorrect in an objective sense (Eden et al., 1983).

In contrast, influence diagrams offer a greater degree of formality which better aids theory-building. They are able to describe situations both qualitatively and quantitatively by enabling specification of function, relation and scale in both deterministic and probabilistic cases (Howard and Matheson, 2005). They also enable the strict temporal ordering of decisions and events (Goodwin and Wright, 2009).

3.7.3 Influence diagrams - outline and use

Influence diagrams model situations by describing events and decisions as nodes and relationships as arcs. An overview of the notation is provided below (Er and Lezki, 2012).

1. *Decision node* - describes a decision which is represented as a square or rectangle.

2. *Event node* - describes an act or event which is represented by a circle.

3. *Value/utility node* - describes the anticipated benefit of the situation which is represented as a diamond.

4. *Conditional arc* - is directed towards an event or value node. It describes that the event or value is influenced by a prior decision or event.

5. *Informational arc* - is directed towards a decision node. It describes that a decision is influenced by a prior decision or event.

The different directed arcs within an influence diagram are illustrated in Fig. 3.5. A simple influence diagram displaying use of the method is illustrated in Fig. 3.6. The diagram displays a situation comprising an event, decision and utility node. The decision has alternatives which are d1 and d2. The event has outcomes x1 and x2. The decision and event operate independently of each other. The utility of the situation, u(d, e) is dependent on both the decision and event.

3.8 Model visualisation method

Soft systems methodology, (SSM), is an organised and flexible approach to addressing the complexity of real world situations that require intervention for improvement (Checkland, 2006).

SSM addresses the complexity of situations being seen from differing perspectives through the notion of worldviews, i.e., weltanschauung. SSM is not prescriptive, it is flexible providing a set of principles which can be applied to

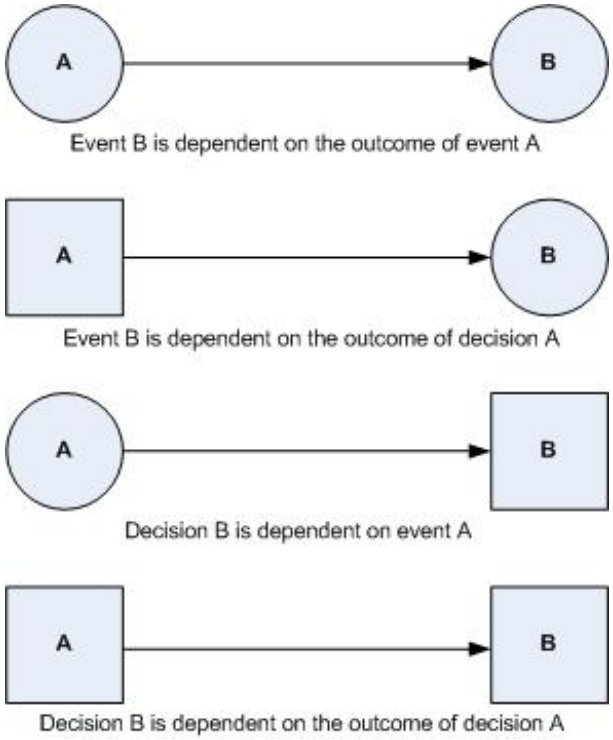


Figure 3.5: Influence diagram definitions

real-world situations where actions can be taken to improve them. The core notion of SSM is of a system which adapts to changes in its environment.

SSM is not a description of processes or activities in a firm. It is a device to carry out a purposeful activity as described in the root definition and CATWOE. It is a means for developing questions to ask of a real situation to gain an insight.

Broadly, two types of situation are addressed using SSM; situations that involve identifying how to carry something out or situations that involve identifying what a situation should comprise. These two uses of SSM are termed SSM(p) and SSM(c), i.e. process and content. The first models to be developed using SSM are often SSM(p).

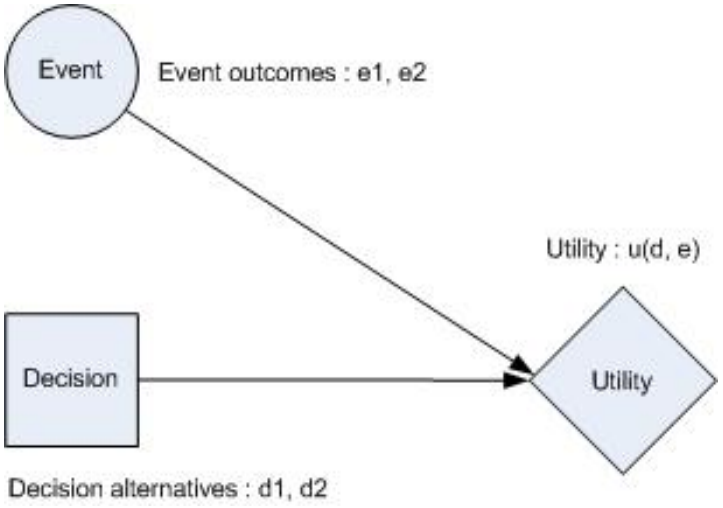


Figure 3.6: A simple influence diagram

3.9 Model testing - data collection method

3.9.1 Semi-structured interviews

Interviews are a purposeful discussion between two or more people (Kahn and Cannell, 1957). They are a widely employed technique in qualitative research for collecting primary data relevant to a research question and objectives. Interviews can range from those that are standardised, structured and formal to those that are non-standardised, unstructured and free ranging. Between theses two extremes are semi-structured interviews which share aspects of both structured and unstructured interview techniques. The interview technique employed should be appropriate to the research question.

A semi-structured interview technique is employed for the deductive theory-building stage of this study as it is the most appropriate interview technique for addressing the exploratory and explanatory nature of the research question and objectives (Cooper and Schindler, 2008). Semi-structured interviews are used to explore how well the framework fits real-world practices and processes for outsourcing innovation, whether they confirm or contradict the framework, i.e., 'find out what is happening and seek new insights' (Robson, 2002). If a contradiction between the framework and real-world process & practices, (i.e., anomaly), is

identified during the interview, an explanation is sought in order to understand the relationships between the constructs of the framework. A semi-structured interview technique is used so that the innovation outsourcing framework can be informed whilst allowing the capture of meanings that interviewees attach to issues and situations in context (Easterby-Smith et al., 2002). It enables the opportunity to probe answers where it is required of interviewees to explain or build on their responses (Saunders et al., 2009).

3.9.2 Interview protocol & rich picture research instrument

An interview protocol is used to address two main concerns which impact the credibility, transferability and dependability of data collected. The concerns are particularly pertinent due to the complex and cross-discipline nature of the innovation outsourcing phenomenon. Firstly, a criticism that is sometimes made of frameworks that are inductively derived is that the process of categorising and coding data tends to fragment the data. This raises the concern that this may lead to a lack of understanding amongst interview participants of the continuity, dynamic and temporal nature of the innovation outsourcing process. Secondly, the lack of standardisation within interviews raises concerns of possible interview bias where other researchers may not elicit the same data (Easterby-Smith et al., 2008).

An interview protocol is used to promote uniformity of understanding amongst interviewees and address concerns of the credibility, transferability and dependability of data collected. A key constituent of the interview protocol is an interview research instrument, developed using soft systems methodology (Checkland, 2006), to reflect the inductively-derived framework as rich pictures. The interview research instrument is detailed in Appendix A. The use of soft systems methodology to develop rich pictures reflects the systems theory approach in developing the framework. The use of rich pictures enabled the complex nature of innovation outsourcing constructs and the dynamic nature of the innovation outsourcing process to be better communicated during interviews.

3.10 Summary

This chapter has presented a valid and reliable research methodology attained by the transparent and systematic consideration of all the options available to address the main issues of research design.

Chapter 4

Framework Development

This chapter addresses research objective 2(a), to 'inductively develop an archetype framework for successfully outsourcing innovation'. An overview of the chapter is displayed in Fig. 4.1.

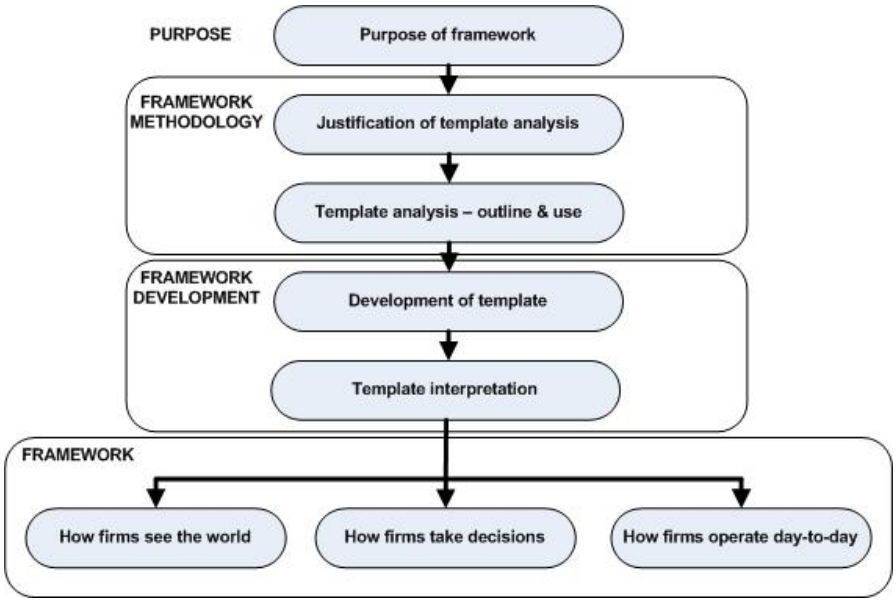


Figure 4.1: Overview of innovation outsourcing framework development

The framework is developed using a technique of template analysis which is applied to an innovation outsourcing literature data set of 248 research articles previously identified in chapter 2 of this thesis document. As a qualitative study,

particular attention is paid to research quality through detailed description and justification of the options and techniques employed.

4.1 Purpose of framework

The purpose of the framework is to simplify and organise innovation outsourcing phenomena in ways that highlight the outcome of interest, i.e., performance through innovation outsourcing.

Development of the framework represents the first two steps of the inductive stage of the descriptive theory-building phase of this study. This is illustrated by the two shaded segments of Fig. 4.2.

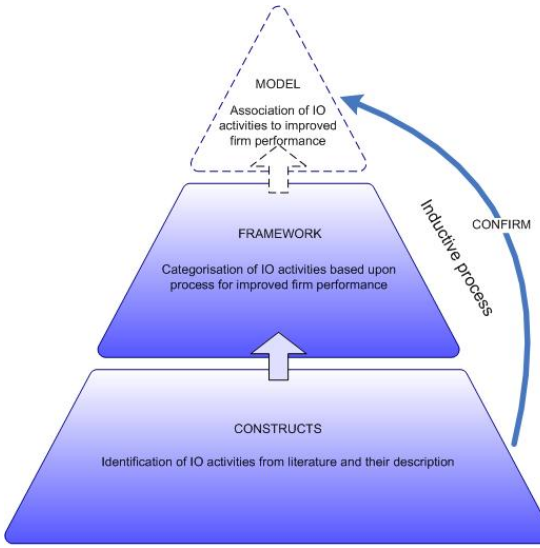


Figure 4.2: Inductive development of innovation outsourcing framework

Innovation outsourcing phenomena are elucidated from relevant qualitative data and appropriate labels are ascribed to form categories. The categories are continually reviewed to identify how they relate to performance and how they are best organised to realise performance. The set of categories and their constituent innovation outsourcing phenomena are interpreted as an archetype to form the

framework. The framework is the bridge between identifying & describing innovation outsourcing phenomena and exploring the relationships between those phenomena.

4.2 Template development

This section thematically analyses the literature data set of 248 research articles to develop a template which provides a holistic perspective on outsourcing innovation.

Credibility, (i.e., how believable are the findings of a study, similar to internal validity), dependability, (i.e., whether a study's findings are applicable at other times, similar to reliability), and confirmability, (i.e., the degree to which a researcher's values have been allowed to intrude in to a study, similar to objectivity), are key criteria for the trustworthiness, (i.e., research quality), of qualitative studies. These criteria are considered integral to this research study which uses the compilation of an audit trail and reflexivity to enhance this study's trustworthiness.

4.2.1 Template audit trail

An audit trail is a documentary record of the steps undertaken and the decisions that are made in moving from the literature data set of innovation outsourcing papers to the final template and its interpretation. Template analysis lends itself to the production of an audit trail. Successive iterations of the template are displayed below with accompanying commentary on the changes made and the rationale for doing so.

4.2.1.1 Document file preparation

In preparation for using the data set with the computer-assisted qualitative data analysis software, (i.e., Weft), it is reviewed to ensure that it is of the correct format for use with the software and is also easily identifiable. Documents comprising the data set are required to be in either Adobe Acrobat 'pdf' format or 'txt' format. The papers comprising the literature data set are almost all in

Adobe Acrobat 'pdf' format. Two papers are in Microsoft Word format which are converted to 'txt' format to enable them to be imported in to Weft. The file names of the papers comprising the literature data set are reviewed to ensure that they are easily identifiable reflecting the year the paper was published, the lead author and the title of the paper.

4.2.1.2 Project creation

The Weft software is started. A new project is created, as displayed in Fig. 4.3, and saved as Weft QDA Project file 'io.qdp'.

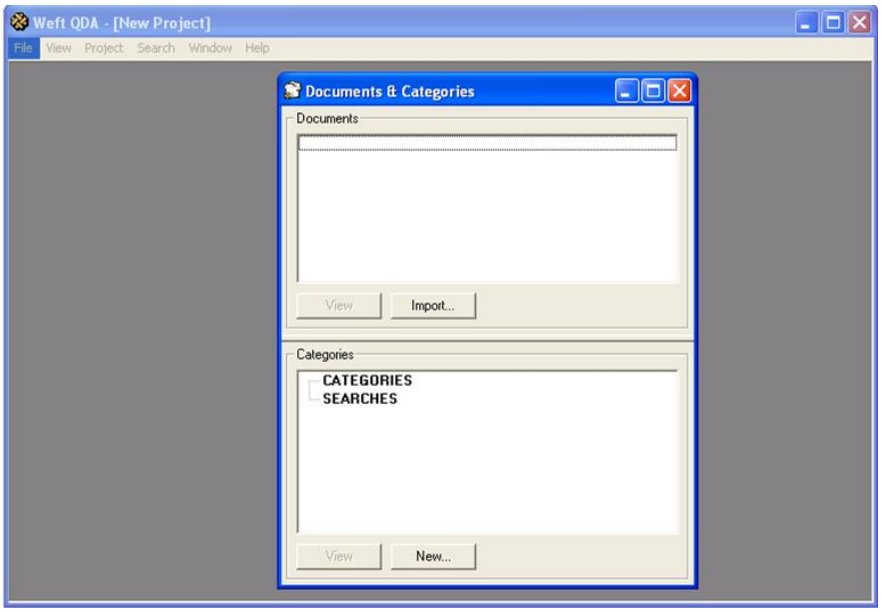


Figure 4.3: Creation of a new project in Weft

4.2.1.3 Importing documents

Commencing with papers published in the current year, each individual document file representing a paper of the literature data set is imported into Weft until all papers which can be imported have done so. The papers imported in to Weft are displayed in the list of documents window, Fig. 4.4, within Weft. A small number of papers could not be imported in to Weft. This was due either to the

Figure 4.4: List of papers imported into Weft

electronic format of some of the older papers not enabling the extraction of text, or the paper's electronic security restricting sufficient access to import its content. Where papers could not be imported in to Weft, they were coded manually.

4.2.1.4 First iteration

Template analysis often, but not always, begins with identifying some initial themes in advance. The use of initial themes is dependent on the methodological and epistemological position adopted by a study. They are justified within this study due to the realist position adopted by this study where there is *á* priori awareness of the innovation outsourcing phenomenon. This is evident in the papers that are used as the data set. The *á* priori themes are tentative and are redefined or removed according to the data that emerges.

The identification of *á* priori themes is guided by the definition of innovation outsourcing synthesised in a previous chapter and this study's research aim

& objectives. Innovation outsourcing is defined as 'a strategic decision involving the antecedents, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries'. The aim and objectives of this study is to develop a generic holistic approach by which firms can successfully outsource innovation, by exploring the process, key practices and associated factors which influence a firm's ability to outsource innovation effectively. Consideration of these factors identifies, 'Antecedents', 'Processes', and 'Implications' as the three *á* priori themes. The initial themes are restricted to three themes to prevent the pre-judgement of outcomes and to aid credibility of the study, whilst being sufficient to initially address the research objective of this study.

The three *á* priori themes, (i.e., 'Antecedents', 'Processes', and 'Implications'), comprising the initial template are created as new categories beneath the empty category tree within Weft, Fig. 4.5, and are displayed as:

1. Antecedents
2. Processes
3. Outcomes

Starting with papers published in the year most recent, each paper is opened within Weft and read from beginning to end without interruption. The same paper is read again and pertinent sections of text identified. When identifying sections of text, the research question is kept at the forefront of the mind and consideration is given to what the section of text represents, i.e. what is happening here? Sections of text are associated and linked to a category by selecting the category from within the category tree in the documents & categories window, highlighting the section of text within the document and clicking the 'Mark' button. Examples of text linked to categories are:

> 'The results show that the emerging shortage of highly skilled science and engineering talent in the US and, more generally, the need to access qualified personnel are important explanatory factors for offshoring innovation decisions' [Note - 'Offshoring refers to the process

Figure 4.5: Initial template of three *á* priori themes

> of sourcing and coordinating tasks and business functions across national borders. Offshoring may include both in-house (captive, or international in-sourcing) and, increasingly, outsourced activities that are performed by an external provider - that is, from outside the boundaries of the firm'] (Lewin et al., 2009)

linked to the category 'Antecedents'.

> 'The business model underpinning Fiat's highly outsourced NPD strategy was not geared to the recognition and incorporation of useful knowledge from outside the organization. Like most of its strategic decisions, it was influenced by the company routines that aimed to reduce costs. The result of this highly outsourced opening of NPD and downsizing of in house NPD divisions was an erosion of Fiat's architectural knowledge. Under this system, Fiat developed core products

> that were badly received by consumers, and thus its sales continued to decline.' (Ciravegna and Maielli, 2011)

linked to the category 'Processes'.

> 'Apparently, we far better understand why companies expect to profit from outsourcing R&D as compared with how they actually benefit' (Hsuan and Mahnke, 2011)

linked to the category 'Outcomes'.

The coding procedure of reading a paper, identifying pertinent sections of text, marking & assigning sections of text to a category is repeated for each paper within the list of documents imported in to Weft.

Reflection on first iteration: Reflexivity is an essential and integral aspect of qualitative research. It concerns reflecting on the nature of individual involvement in the research process. It especially concerns being aware of assumptions which may have influenced outcomes about the phenomenon under investigation.

Where a section of text within a paper is not covered by an existing theme or category, template analysis enables a new category to be created within Weft. The term theme within template analysis and category within Weft are refer to the same concept and are used interchangeably within following discussions.

During the coding process it was not deemed necessary to create any additional top-level themes to the three initial themes: antecedents, processes, and outcomes. This confirms that the initial three themes are sufficient to address the research question.

Reflection on the sections of text associated with the theme 'antecedents' identifies that they are concerned with the environment in which the innovation outsourcing phenomenon occurs, the global environment and the firm environment. This is in keeping with systems theory where a key characteristic of open systems is interdependence with the environment. To reflect this insight, the category, 'antecedents' is renamed 'environment' and two categories are created at a level below it, 'global' and 'firm'.

The sections of text associated with the category 'processes' seem to concern the selection and implementation of innovation outsourcing. Consequently, two categories, 'Selection' and 'Implementation' are created at a level below the category 'processes'.

A close examination of the text associated with the 'outcomes' category identifies that the sections of text refer to either a broad outcome of improving firm performance through specific *expected* outcomes, (e.g., expectation of reducing costs), or the outcomes of individual innovation outsourcing procedures, (e.g., protecting core capabilities). Sections of text that refer to *expected* outcomes are re-categorised as 'processes' because they concern rationale for outsourcing innovation and not *actual* observed outcomes of innovation outsourcing. Similarly, outcomes of individual innovation outsourcing procedures refer to the rationale for specific procedures, and are also re-categorised as 'processes'. Reflection of the remaining sections of text identifies that there does not exist any data about *actual* observed positive outcomes of innovation outsourcing beyond generalised statements of improved firm performance. There does exist some data about *actual* observed negative outcomes of innovation outsourcing (Ciravegna and Maielli, 2011) (Amaral et al., 2011). To reflect the remaining data associated with the category outcomes, it is renamed 'Firm performance'.

The template after reflection of the first iteration, displayed in Fig. 4.6, is:

1. Environment
    (a) Global
    (b) Firm
2. Processes
    (a) Selection
    (b) Implementation
3. Firm Performance

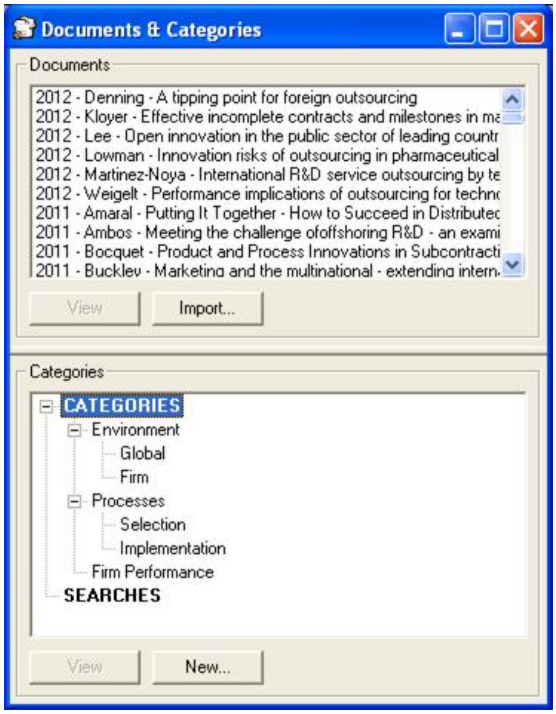


Figure 4.6: Template after reflection of the first iteration

4.2.1.5 Second iteration

The second iteration of template analysis involves reviewing the sections of coded text associated with each top-level category, (i.e., environment, processes and firm performance), to refine the categorisation. Category refinement occurs as a result of associating coded text with lower-level categories identified as a result of reflection in the first iteration of template analysis or as a result of categories 'emerging' out of sections of coded text. The pragmatic intent kept in mind whilst 'coding-on' and refining the categorisation of sections of text is. 'how does coding the text in this way help build an understanding of innovation outsourcing'?

Environment: Examples of text linked to the Environment categories are:

> 'Northern entrepreneurs participate in two simultaneous R&D races to innovate higher quality products: localsourcing-targeted and outsourcing-targeted R&D races. The winner of the former race can only man-

> ufacture in the North, facing higher labor costs. The winner of the latter race can immediately produce in the South, enjoying lower labor costs. Participation in an outsourcing targeted R&D race requires engagement in a broadly-defined R&D activity that involves not only scientists and engineers working on innovations but also a sophisticated management team that globally coordinates the innovation and technology transfer efforts of a multinational firm.' (Sener and Zhao, 2009)

linked to the category Environment/Global.

> 'Outsourcing is most likely when specific assets are required, behavioral uncertainty is low, intellectual property is well protected, the activity is not seen as a path to developing competitive advantage and when low cost is not the primary goal of the development effort. Also, large firms have a greater tendency to outsource.' (Stanko and Calantone, 2011)

linked to the category Environment/Firm.

Review of the sections of text remaining identifies the need for a level of understanding, amongst managers and employees, of innovation outsourcing and its characteristics for it to be adopted by a firm. An innovation outsourcing cognitive environment is necessary for a decision to outsource innovation to occur. A new 'cognitive' category is created within the environment category to which appropriate sections of text are coded. An example of text associated with the category Environment/Cognitive is:

> 'At the core of successfully managing outsourced innovation is an exciting vision that inspires internal and external people to work together with energy. Such visions are essential in outsourcing because daily line contact is impossible and technical people feel free to jump to wherever the action and rewards look most exciting.' (Quinn, 2000)

Firm strategy: The input to the innovation outsourcing process is a decision to outsource innovation which is influenced by the environment in which it occurs. A search is undertaken using Weft for papers containing the word 'decision'. The search is not limited to whole words or case sensitive. The amount of additional text specified around each search result is 200 characters. The text returned is reviewed to identify their relevance. The papers containing text relevant to the initial decision to outsource innovation are read again and pertinent sections of text identified.

The decision to outsource innovation is undertaken at a senior level within firms and consequently forms part of a firm's strategic plans. A top-level category of 'Firm Strategy' is added to the template. Pertinent sections of text previously identified are coded and associated with the new category. An example of text associated with the category firm strategy is:

> 'a strategic decision which enhances a firm's capabilities by substituting or complementing its internal innovation activity with that sourced externally via a formal agreement' (Love and Roper, 2001).

Processes: The sections of text associated with the category 'processes' are individually reviewed to identify whether they are concerned with the process of selection or implementation. Sections of text relating to the process of selection concern processes identifying the innovation activity a firm can outsource. Sections of text relating to the process of implementation concern processes relating to how firms outsource innovation.

Some sections of text are easily identifiable as relating to either selection or implementation categories. For example, sections of text relating to processes for protecting a firm's core competencies can be confidently stated as relating to the process of selection. There were, however, several sections of text which were difficult to assign to either selection or implementation categories because an argument could be made for them to be assigned to either category. For example, the following section of text relating to offshore locations of innovation activity can relate to either or both selection and implementation categories.

> 'Following from our result that companies choosing offshore outsourcing have a higher probability of implementing an offshoring strategy, future research may investigate whether the introduction of an offshoring strategy could indeed offset some coordination and managerial challenges faced by companies who in the past opted for stronger control in offshore captive operations, which in fact may not always be the best choice due to the small scale of projects' (Massini et al., 2010).

The decision to select an offshore location for outsourced innovation activity is dependent on initially implementing an offshoring strategy. It was deemed incorrect to assign the above text to either or both selection and implementation categories.

Due to the various and several sections of text where it was difficult to assign to either selection or implementation categories, these categories were removed from the template.

Reflection on second iteration: Reflection on the template at this stage identifies that further coding of the categories, Environment, Firm Strategy and Firm performance will not illuminate the data set to enlighten the research question. Coding of the category Processes is to be progressed in a further iteration of the template by a closer and more granular examination of the textual data associated with the processes category. The template after reflection of the second iteration, displayed in Fig. 4.7, is:

1. Environment
   (a) Global
   (b) Firm
   (c) Cognitive
2. Firm strategy
3. Processes
4. Firm Performance

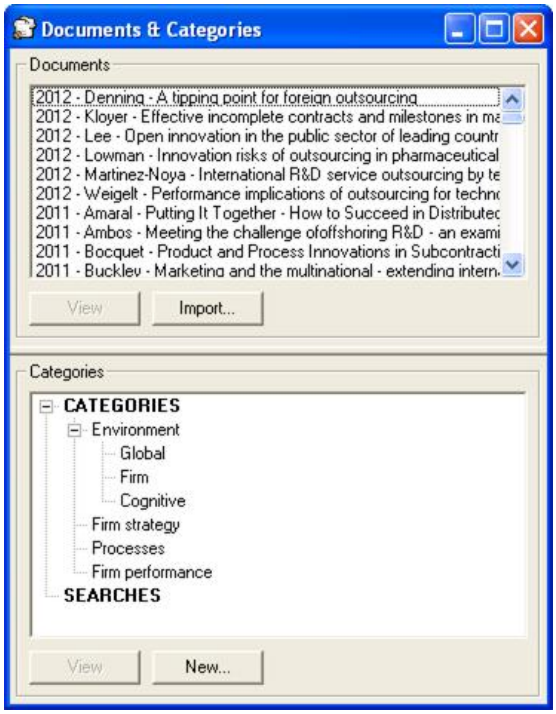


Figure 4.7: Template after reflection of the second iteration

4.2.1.6 Third iteration

The third iteration of template analysis involves reviewing the sections of coded text associated with the top-level category processes. The research question and objectives are again examined to guide the coding process, revealing a focus for innovation outsourcing capabilities and key practices.

Processes: The sections of text associated with the processes category are examined to identify capabilities and practices for outsourcing innovation. Examples of capabilities and practices identified include those for: protecting core capabilities; determining innovation outsourcing expectations and rationale; determining locations; identifying potential partners; suitable governance and control; managing projects, and; managing across boundaries. For example, the following section of text relates to protecting core competencies:

> 'Product development managers need to have a clear sense of which

> activities create and sustain shareholder value, and which do not. Activities deemed to be noncore can often be safely outsourced. The trick is distinguishing between these and the core activities, the latter should be the organization's focus.' (Amaral et al., 2011).

Examination of the innovation outsourcing capabilities and practices identifies that they can be organised according to the individual process concerns that they address, i.e.: What innovation activity is to be outsourced? - e.g., differentiating between core and noncore competencies; Why the innovation activity is to be outsourced? - e.g. determining the rationale for outsourcing; Where innovation activity is to be outsourced? - e.g., determining outsourced location; to Whom innovation activity is to be outsourced? - e.g., identifying potential partners and suppliers; How innovation activity is to be outsourced? - e.g., Managing outsourced activity across boundaries. These are reflected as new categories within Weft and appropriate sections of text coded to them. The Processes section of the template at this point, displayed in Fig. 4.8, is:

1. Processes
    (a) What innovation activity is to be outsourced
    (b) Why the innovation activity is to be outsourced
    (c) Where the innovation activity is to be outsourced
    (d) to Whom innovation activity is to be outsourced
    (e) How innovation activity is outsourced

A review of the sections of text coded to the above categories identifies that the text associated with the category 'How the activity is to be outsourced' comprises some that relates to how outsourced activity is managed and some that relates to how a firm's structures and procedures should be designed for effective innovation outsourcing. The text relating to how outsourced innovation is managed is removed from the category and associated to a new category 'How outsourced innovation is managed'. The processes section of the template at this point is displayed below:

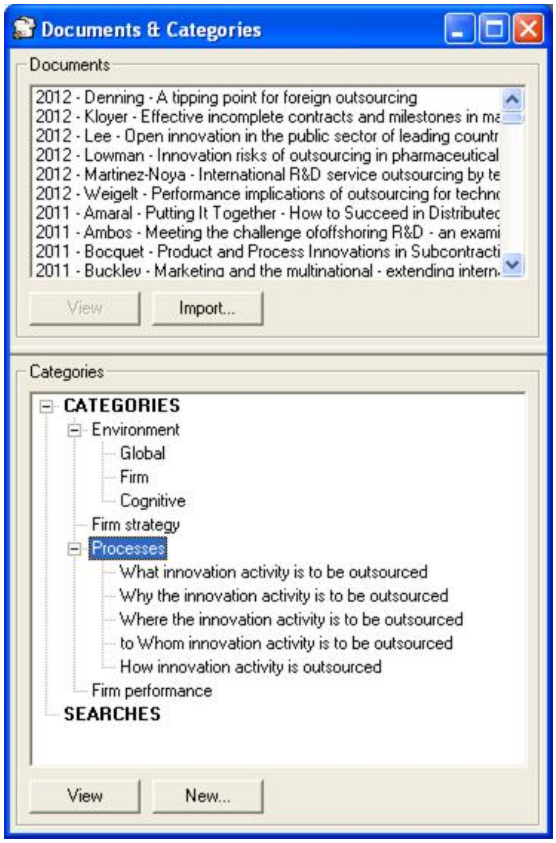


Figure 4.8: Template at the third iteration

1. Processes

   (a) What innovation activity is to be outsourced

   (b) Why the innovation activity is to be outsourced

   (c) Where the innovation activity is to be outsourced

   (d) to Whom innovation activity is to be outsourced

   (e) How innovation activity is outsourced

   (f) How outsourced innovation is to be managed

Reflection on third iteration: Reflection on the text associated with the processes category identifies a close relationship between the selection of innovation

activity to be outsourced and the implementation of outsourced activity. This is due to the selection of innovation activity to be outsourced being dependent on there existing appropriate firm structures and procedures for outsourcing innovation. Procedures concerning the determination of innovation activity to be outsourced can be more precisely described as procedures for 'What innovation activity can *potentially* be outsourced. It is the existence of supporting structures and procedures relating to the categories, 'Where the innovation activity is to be outsourced', 'to Whom innovation activity is to be outsourced', and 'How innovation activity is outsourced' which determine the successful and consequently *actual* innovation activity that is outsourced. A category, 'What innovation activity can, *in reality*, be outsourced' encapsulating these categories is added to the template. Category names are reviewed to ensure that they describe precisely their intent. The processes section of the template at this point, displayed in Fig. 4.9, is:

1. Processes
    (a) What innovation activity can *potentially* be outsourced.
    (b) Why particular innovation activity should be outsourced.
    (c) What innovation activity can, *in reality*, be outsourced.
        i. Where innovation should be outsourced.
        ii. to Whom innovation should be outsourced.
        iii. How innovation should be outsourced.
    (d) How outsourced innovation is to be managed

Final template: Reflection on the complete template identifies that further coding will not illuminate the data set to enlighten the research question. The final template, displayed in Fig. 4.10, is:

1. Environment
    (a) Global
    (b) Firm

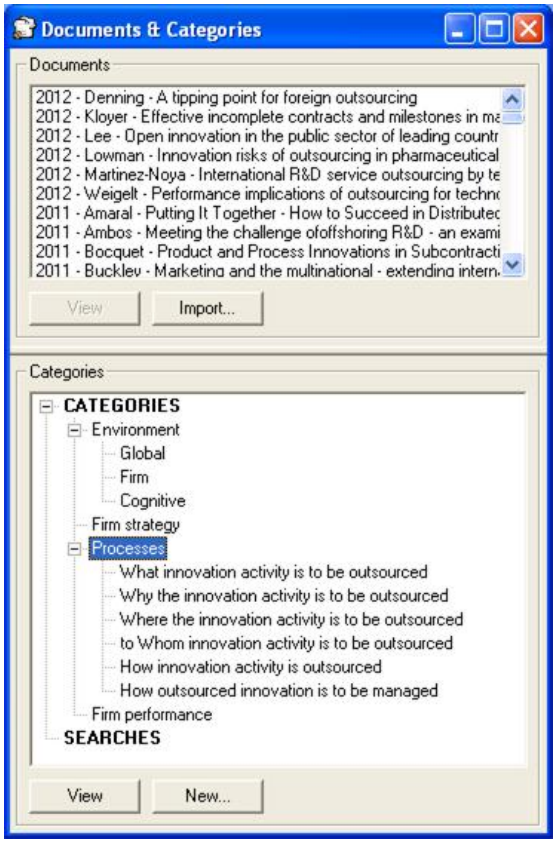


Figure 4.9: Template after reflection of the third iteration

(c) Cognitive

2. Firm strategy

3. Processes

   (a) What innovation activity can *potentially* be outsourced.

   (b) Why particular innovation activity should be outsourced.

   (c) What innovation activity can, *in reality*, be outsourced.

      i. Where innovation should be outsourced.

      ii. to Whom innovation should be outsourced.

      iii. How innovation should be outsourced.

(d) How outsourced innovation is to be managed

4. Firm Performance

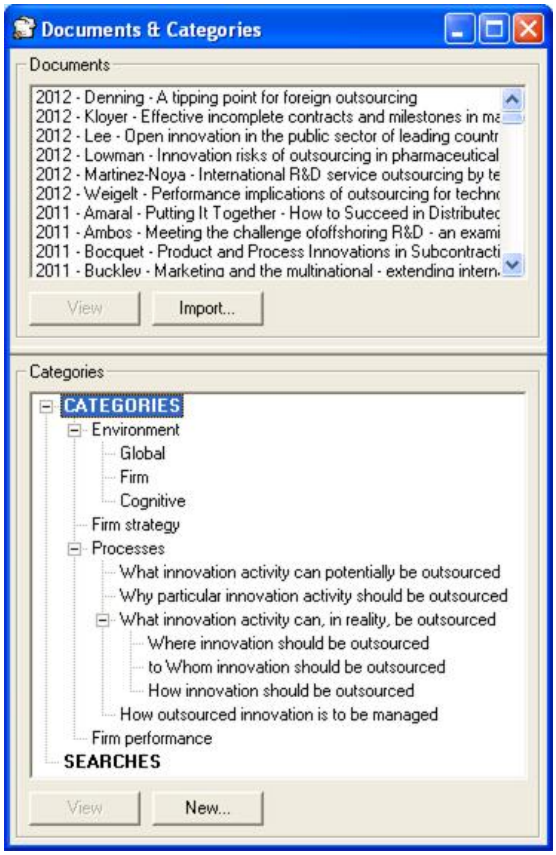


Figure 4.10: Final template

4.3 Template interpretation & framework

The final template displayed above serves as a tool to gain insight from the data, using its richness to help address the research aim of developing a generic holistic approach by which firms can successfully outsource innovation.

The template is used to inform an archetype, (i.e., an 'ideal' representation), for successfully outsourcing innovation. The archetype offers a 'holistic' per-

spective and can be considered in terms of three core elements (Greenwood and Hinings, 1993):

1. How they see the world, i.e., 'interpretive schema'
2. How they take decisions
3. How they operate day-to-day

An interpretive schema is the notion of how firm's see the world. It forms the values, beliefs and ideas which underpin and are embodied in a firm's organisational structures and systems. How firms take decisions concerns their strategy and resulting resource allocation. How firms operate day-to-day concerns their routines and consequent structures and procedures.

Interpreting template themes requires making judgements concerning the salience of themes that address the research aim of this study. The top-level environment template theme and its associated themes, i.e., global, firm and cognitive, are used to illuminate how firm's see the world. The top-level processes template theme and its associated themes, (excluding the theme 'how outsourced innovation is to be managed'), are used to illuminate how firms take decisions relating to outsourcing innovation. The template theme 'How outsourced innovation is to be managed' is used to illuminate how firms operate day-to-day.

The framework resulting from the interpretation of the template as an archetype for successfully outsourcing innovation is illustrated in Fig. 4.11. The framework is detailed in sections 4.4, 4.5, and 4.6, which display the results of analysing the literature data set of 248 research articles thematically. They describe the themes, summarise and critically review the papers by theme.

4.4 How firms see the world

Firms that outsource R&D have a particular view of the world. This view guides their actions and ultimately determines the structures and systems which are embodied in their organisation. Constructs concerning a firm's interpretive schema are identified below.

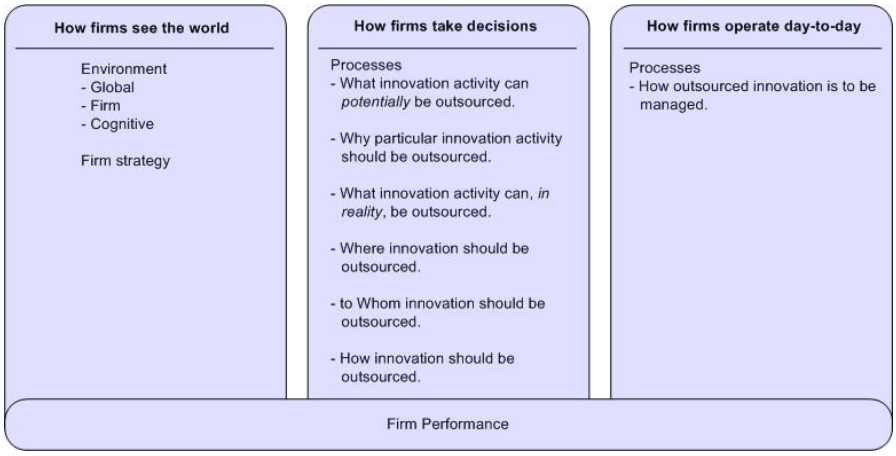


Figure 4.11: Innovation outsourcing framework

4.4.1 Global view

Innovation outsourcing factors which form part of a firm's global perspective are identified below:

4.4.1.1 Globalisation

Increased globalisation, (i.e., the dismantling of national barriers relating to markets and production), drives outsourced R&D (Sener and Zhao, 2009) (Ernst, 2006). The liberalising of economies by governments creates enabling environments (Gersbach and Schmutzler, 2011) (Gobble, 2010) (Kleyn et al., 2007) for firms to outsource R&D in industries as diverse as pharmaceutical, minerals, petroleum (Cosner, 2009) and manufacturing (Macpherson, 2008). This phenomenon exists in both Eastern and Western economies (Cass, 2007). A significant flow of outsourced R&D from Eastern economies to the USA is observed in addition to that from Western economies to China and India. Industry examples which have experienced globalisation driven outsourced R&D are pharmaceutical and minerals.

The pharmaceutical industry has seen continuous pressure from regulatory authorities, rising R&D costs and a depreciation in the value of its patents. In particular, the cost of conducting clinical trials in Western economies is becoming

more significant in the overall drug development structure (Howells et al., 2008). Many pharmaceutical firms are outsourcing clinical trials to India which has a low-cost, well-resourced, highly-skilled health infrastructure and where patient recruitment is faster and easier (Cekola, 2007).

The minerals industry has undergone significant structural change with its increasing globalisation (Upstill and Hall, 2006). Minerals firms no longer see local centralised R&D knowledge as sufficient to gain competitive advantage. Instead they are forming global R&D networks to interact with a wide range of expertise to globally exploit technology. Minerals firms have outsourced innovation to gain access to new technologies such as; satellite and remote sensing applications for exploration, and e–procurement to standardise equipment across their global operations.

The impact of globalisation on innovation activity is not pervasive across all industries. In contrast, innovation in the semiconductor industry remains remarkably un-globalised. The patenting activity of large US semiconductor firms remains predominantly US-based. Patenting by non–US semiconductor firms is, similarly, domestically based, although, the US is the predominant location for offshore inventive activity (Macher et al., 2007).

4.4.1.2 Uncertainty

A firm's propensity to outsource innovation is impacted by environmental uncertainty, i.e., 'the perceived inability of an organisation's key manager or managers to accurately assess the external environment of the organisation or the future changes that might occur in that environment' (Milliken, 1987). There are multiple sources of uncertainty to which R&D activities are subject (Colvin and Maravelias, 2011), including market size, new technologies and intensity of imitation. The larger the market for technology, the stronger the advantages to substitute internal R&D with outsourcing, and to increase the degree of product diversification (Cesaroni, 2004). Uncertainty in technologies is positively associated with high-scope outsourcing (Mol et al., 2004). An increase in the intensity of imitation reduces the propensity to outsource innovation (Glass, 2004).

Changing levels of uncertainty impact how firms are organised. Firm sourcing decisions and firm boundaries evolve as uncertainty fluctuates (King, 2006). Under high uncertainty, firms collaborate and outsource innovation to lower risk. Decreased uncertainty and maturing technology build pressures for firms to consolidate. As uncertainty declines, firms acting as suppliers are likely to challenge establish firms. To remain competitive, firms need to be proficient in multiple sourcing methods and adapt as an industry's environment changes and matures.

4.4.1.3 New economic paradigm

A new economic paradigm is replacing the old (Birchall et al., 2001). Previously, firm success was derived from exploiting products using economies of scale within a tightly integrated value chain where innovations were incremental. Firm success is now increasingly derived from the economies of scope within deconstructed value chains where innovations are not necessarily incremental (Chesbrough and Crowther, 2006).

Firms are increasingly recognising their limitations with respect to the knowledge they require to compete successfully in the new economic paradigm. Sourcing of external knowledge is increasingly becoming a key factor in building a position of sustained competitiveness as markets continue to globalise and move to knowledge-based services. Consequently, new patterns of innovation are emerging with a shift from a slow largely internal and sequential process to a rich, dynamic process that encompasses a broad spectrum of knowledge sourcing, partnering and value capture options (Birchall et al., 2001).

Totally new capabilities as well as the refinement of many existing capabilities are essential for firms to retain a dominant position in the new economic paradigm. The new capabilities are focussed largely on building and maintaining relationships in increasingly networked business partnerships. This involves the design and building of appropriate organisational architectures and the capability to reconfigure constantly to meet changing customer demands. It implies capabilities in sourcing supply capability as opposed to products (Birchall et al., 2001).

4.4.1.4 Talent pool

Continuous innovation, and ultimately firm success, is dependent on a rich and uninterrupted source of technology talent. Globally, the supply of scientists, technologists and knowledge workers has grown enormously (Quinn, 2000).

Whilst there has been a continual decline in the numbers of technology talent in the Western economies, there has been a rapidly growing pool of highly-skilled talent in the emerging economies (Manning et al., 2008) (Lepkowski, 2007). Western nations have failed to attract sufficiently highly-skilled talent from abroad whilst emerging economies have successfully implemented national policies and tax incentives to reverse the brain drain. Emerging economies are also rapidly developing their infrastructure and institutions to attract increasing numbers of foreign operations, whilst western innovation policies struggle to keep pace with global offshore developments (Manning et al., 2008). Asia's talent pool has seen major expansion, albeit at the cost of declining quality. Nevertheless, knowledge workers in Asia are much cheaper than in the West driving a quadrupling of R&D offshoring. The need to access qualified personnel is an important explanatory factor for innovation outsourcing decisions (Lewin et al., 2009). Firms are entering a global race for talent. Firms are not only diversifying resources for talent but entering an era where they must compete for talent.

4.4.1.5 External linkages

The scale of external linkages is increasing dramatically. Firms are increasingly adopting open R&D structures (Jelinek and Bean, 2010) whilst governments implement policies where national and international collaboration is central to their R&D framework program (Gobble, 2010) (Gwynne, 2002).

A longitudinal study of New York Sate manufacturers identifies that up to 90% of a product's R&D can be sourced externally (Macpherson, 2008). This has driven the outsourcing of research, design and product development activities at levels far in excess of those in the 1990s.

The increase in external linkages is also being driven by the public sector being increasingly opened up to private sector involvement. A study of activity linkages between Chinese public sector organisations and private firms identified

that Chinese science and technology outsourcing activities increased significantly between 1996 and 2002 (Motohashi and Ziao, 2007). The US federal government is also encouraging national laboratories to make their research available to the private sector. The release of IP from national laboratories presents a wealth of opportunities for new partners including small start-ups.

4.4.1.6 Legal regimes

Laws to adequately safeguard intellectual property rights, (IPR), are a key consideration for firms when outsourcing innovation (Garca-Vega and Huergo, 2011) (Cusmano et al., 2010). When making product innovation outsourcing decisions, IPR factors dominate over cost factors, and firms are reluctant to outsource unless their IPR are adequately protected (Gooroochurn and Hanley, 2007). This is confirmed by (Chen and Yuan, 2007) who identify that inadequate institutional safeguards for technology transfer contracts discourage domestic innovation outsourcing in China. An increase in the intensity of imitation reduces the rate of innovation and the extent of outsourcing, whilst outsourcing is increased by a lowering of the risk of imitation (Glass, 2004). A strong IPR protection regime encourages innovation outsourcing, whilst a weak IPR protection regime discourages innovation outsourcing.

The agreement on trade-related aspects of intellectual property rights, (TRIPs) introduced IP law in to the international trading system. The impact of TRIPs is that it can boost both outsourcing and local-sourced-targeted R&D activities (Sener and Zhao, 2009). Governments, especially in the emerging economies, have also taken steps to protect their innovation intensive industries. Both India and China have implemented strong patent regimes to encourage inward investment from innovation outsourcing (Rao, 2008). India, especially, has modified its intellectual property laws to protect foreign investment, through innovation outsourcing, in its pharmaceutical industry (Cekola, 2007).

4.4.2 Firm view

Innovation outsourcing factors which form part of a firm's internal perspective are identified below. Predictive characteristics of firms which have the propensity

to outsource R&D may encourage firms who do not outsource R&D to review whether they may potentially benefit from doing so.

4.4.2.1 Firm size

Small to medium sized firms (SMEs) are more likely to outsource innovation than large firms. SMEs tend to maintain a small range of technological competencies and use their limited R&D resources efficiently (O'Regan and Kling, 2011) (Sen and Haq, 2011) (Rothwell and Dodgson, 1994). They tend to be more flexible and astute, using almost twice as much of their R&D expenditure than large firms on innovation outsourcing (Narula, 2004). Small companies more often tap external resource sources in order to acquire skills, knowledge, capabilities or operational flexibility (Hatonen, 2010). Medium-sized firms are more involved in outsourcing non-core activities than are smaller firms (Sen and Haq, 2010).

4.4.2.2 Research intensity

Traditionally, being R&D intensive has been seen as a negative predictor of outsourcing. This is due to the advantages of scale enabling firm's greater vertical integration (Harrigan, 1985), and innovations being difficult to acquire if they are not performed within the firm (Teece, 1986). Whilst, historically this may have been true, there has been a clear reversal of this in the 1990's. Now, R&D intensity is seen as a positive predictor of changes in the extent of outsourcing (Mol, 2005). This may be due to shorter product life-cycles where the competitive need to rapidly launch new products has shifted the focus of innovations from in-house to outside the boundary of the firm. Firms who undertake a great deal of exploratory research have a greater propensity to outsource innovation (Calantone and Stanko, 2007) (Rundquist and Halila, 2010). Due to the exploratory nature of the research, firms may be led away from their competencies and are more likely to require expertise not within the bounds of the firm. As this occurs infrequently they are more likely to seek this expertise through outsourcing rather than develop the competencies within the firm. Such firms also aim to cooperate with firms of world-class knowledge (Rundquist and Halila, 2010). Research intensive firms tend to cooperate with universities and research institutes whilst

those firms that are less research intensive cooperate with suppliers. In contrast, (Sen and MacPherson, 2009) finds no correlation between outsourcing and R&D intensity.

4.4.2.3 Productivity

Firms experiencing declines in internal productivity are more likely to engage in an outsourcing-type acquisition in an effort to replenish research pipelines (Higgins and Rodriguez, 2006).

As assets become more specific, contracting for them becomes more difficult. Firms possessing specialised innovation assets and stronger R&D productivity are less likely to source technologies from outside their boundaries (Ceccagnoli et al., 2010). Firms with high levels of specialised innovation assets should take care to manage internal productivity as they may be pushed in to technology markets with a weakened bargaining position as productivity falls.

4.4.2.4 Learning

Firms that place a high value on learning effects and currently possess a low level of knowledge are more likely to outsource innovation (Calantone and Stanko, 2007). Such firms are motivated to learn from outside the boundaries of the firm through outsourcing and more likely to organise and resource internal organisational structures to do so. Firms which place a high value on learning effects and currently possess a high level of knowledge protect their knowledge by limiting their level of innovation outsourcing. Firms which do not place a high value on learning are unlikely to outsource innovation.

4.4.2.5 Financial factors

Financial factors such as high inventory turnover, profit margin, and employee sales efficiency have been identified by (Calantone and Stanko, 2007) as indicators of a propensity to outsource R&D.

4.4.3 Cognitive view

Global innovation models are changing (Wolff, 2006) and decision makers must re-examine their mental models in light of these changes (Wind, 2006). Innovation outsourcing contrasts with the traditional closed innovation paradigm where firms wholly resource, develop, own and market their innovations from within their bounds. Innovation outsourcing emphasises the potential of external R&D resources to create value and the building of internal capability to take advantage of it. Potential cognitive challenges to firm decision makers are identified below.

4.4.3.1 Outsourcing

The traditional view of outsourcing as a make or buy decision does not fit well with outsourcing knowledge activities such as R&D (Mudambi and Tallman, 2010). Outsourcing R&D involves the production of knowledge and innovation where firms seek a governance structure that will both protect and leverage their strategic knowledge assets.

4.4.3.2 Openness

The core principle of openness is that firms, in the long-run, cannot innovate in isolation and stay ahead of the competition (Chesbrough, 2003). It is argued that "open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as firms look to advance their technology". The definition of openness is clarified by (Dahlander and Gann, 2010). They identify two inbound processes: sourcing and acquiring, and two outbound processes: revealing and selling. Acquiring and selling are financial processes whilst sourcing and revealing are not.

Revealing refers to how firms reveal internal resources to the external environment (Dahlander and Gann, 2010). It is a non-financial process and firms do not undertake it with the aim of immediate financial rewards. Revealing is undertaken for its indirect benefits. It aids in gaining legitimacy from the external environment and fosters incremental and cumulative innovation. Firms need to be cautious to ensure internal resources are not leaked to competitors. Selling refers to how firms commercialise innovations and technologies through selling

or licensing out resources developed by the firm. It is a financial process which enables firms to benefit from external partners who may be better equipped to commercialise innovations and technologies.

Sourcing refers to how firms scan the external environment for ideas and knowledge from suppliers, customers, competitors, consultants and universities (Dahlander and Gann, 2010). It is a non-financial process where external ideas are absorbed prior to initiating internal R&D. An effective mechanism is required to select external ideas from the many alternatives. Acquiring refers to how firms acquire innovation from the external environment. It is a financial process where innovation can be licensed-in or acquired from partners. The difficulty is in maintaining effective relationships with a large number of partners.

It must be emphasised that open innovation is no more than a paradigm, it '... is not ipso facto a recipe for outsourcing R&D' and that it does not '.. imply the outsourcing of the entire R&D function' (Chesbrough and Crowther, 2006). Innovation outsourcing incorporates the paradigm of open innovation and extends it to the process of its realisation, encompassing planning, implementation and outcome.

4.4.3.3 Substitute/complement

Definitions of general outsourcing emphasise it as the sourcing of services *previously* produced internally, i.e. as a substitute for internally produced services. In contrast, innovation outsourcing is a strategic decision which aims to extend a firms' capabilities and can be used to both substitute and complement a firm's internal activities (Chen and Yuan, 2007) (Love and Roper, 2001).

4.4.3.4 Commitment

Outsourcing innovation involves creating a vision that inspires people from within and outside the firm to work together. Communicating exciting goals helps create a shared identity and a sense of energy and delight which encourages people to work together (Quinn, 2000). Senior managers must expect, drive and reward change which cannot be done without commitment. Time horizons are extremely important in framing the sourcing decision (Howells et al., 2003). Consequently,

senior managers must also commit to speed which must come from the top and be promoted throughout the organisation (Drew, 1995).

4.4.3.5 Resourcing

Outsourcing innovation is a strategic decision involving changes to a firm's structures and routines. The benefits of R&D outsourcing can seldom be achieved without additional transaction costs (Ulset, 1996).

4.4.3.6 Adaptability

Outsourcing R&D is not a plan that is set and then forgot. Firms who outsource innovation are required to cultivate a readiness to adapt because outsourcing R&D is an ongoing process that should evolve in response to economic issues, industry dynamics and technological innovation (Amaral et al., 2011). Firms must be able to reassess its structures and adjust appropriately as conditions change (Mudambi and Tallman, 2010).

4.5 How firms take decisions

How firms take decisions concerns their strategy and resulting resource allocation.

4.5.1 What should be outsourced

These are the considerations that a firm uses to determine what it can potentially outsource to improve innovation performance and what it must not outsource in order to protect its competencies. Deciding which R&D activities to outsource is non-trivial because often they are interlinked, obscured by products and functional groups tend to defend their ability to drive strategy (Giao et al., 2008). Careful and appropriate analysis of product and process characteristics is required to guide any decision.

4.5.1.1 Protecting core competencies

A survey of US biopharmaceutical firms identifies that firms are obviously distinguishing between their core and non-core functions (Sen and MacPherson, 2009). The risks of not doing so are displayed in a twenty year longitudinal case study of the motor manufacturer Fiat undertaken by (Ciravegna and Maielli, 2011). Fiat outsourced a large share of the research and development of its core products including product design and engineering using numerous suppliers. The result of this highly outsourced opening of outsourced R&D was an erosion of Fiat's architectural knowledge. Differentiating core value activities when outsourcing is critical. Not doing so results in the hollowing out of the firm's competencies leading to a diminished strategic position (Elango, 2008). Firms should have a clear focus on its core competencies (Festel et al., 2011).

Firms are required to analyse processes at the level of activities, (i.e., a set of related tasks, performed by a single entity resulting in specific deliverables), to identify core and non-core activities (Amaral et al., 2011). Three key steps are used to determine those R&D activities that are appropriate for outsourcing and those which must be kept in-house to ensure the firm's long-term survival.

1. Knowledge boundary: The boundary of a firm can be explained by the advantage it has over the external business environment to effectively create, integrate and assimilate specialised knowledge (Conner and Prahalad, 1996). Defining the knowledge boundary of a firm enables it to understand the scope of its knowledge.

   The knowledge boundary of a firm with the external business environment remains clear cut whilst its innovation is retained in-house, however, there is potential for these lines to be blurred when it outsources R&D. Indeed, (Brusoni and Prencipe, 2001) state that 'the knowledge boundaries of the firm fundamentally differ from the boundaries of the firm as defined by make-buy decisions'. Defining a firm's knowledge boundary also enables it to ensure key knowledge is effectively retained (Amaral et al., 2011).

2. Competency/capability analysis: Determining the significance of a competency to a firm enables it to identify those activities that are critical for the

firm to succeed. Comparing a firm's capabilities in its innovation activities with those of its competitors or potential external providers enables the firm to determine whether it performs a particular activity uniquely well, i.e., forming part of its sustainable competitive advantage, or whether it should possibly be outsourced.

3. Sourcing options: A firm's strategic sourcing options are broadly defined in terms of the two dimensions of competency significance and relative capability. The options are defined by the position of the R&D activity within each of four quadrants:

   (a) Core competency/Less capable - These are crucial innovation activities where external organisations are more capable than the firm. The options are to either invest to perform the activities internally or outsource. The decision to invest to perform the activities internally is dependent on the significance and type of performance disparity.

   (b) Core competency/More capable - These are crucial innovation activities where the firm is more capable than external organisations. The options are to either perform the activities internally or outsource. The decision to outsource is dependent on the significance and type of performance disparity.

   (c) Non-core competency/Less capable - These are non-crucial innovation activities where external organisations are more capable than the firm. These innovation activities are suitable for outsourcing.

   (d) Non-core competency/More capable - These are non-crucial innovation activities where the firm is more capable than external organisations. These innovation activities are not central to the firm and are suitable for outsourcing. If outsourced, the firm will need to aid the development of the external supplier's capabilities to the level achieved internally.

4.5.1.2 Innovation sourcing strategy

Firms can outsource almost any element in the innovation chain, from basic research through to advanced development, from raw ideas to market-ready products (Nambisan and Sawhney, 2007) (Quinn, 2000). Raw ideas are characterised by being high risk, high reach, but low speed and low cost. Market-ready products are characterised by being high speed, high cost, but low risk and low reach. Determining which innovation activity to outsource requires consideration of industry/market factors and company factors (Nambisan and Sawhney, 2007).

Market factors are those that are external to the firm and include: the pace of technological/market change (Bengtsson and Berggren, 2008) (McDermott and Coates, 2007) (Perrons and Platts, 2005a); the extent to which intellectual property rights are defined, i.e., well-defined or poorly defined; market potential for the innovation (Buckley and Casson, 2011); cost of evaluating the innovation; the information required to develop the innovation, i.e., its complexity and necessary level of integration.

Company factors are those that are internal to the firm and include: the purpose of innovation, i.e., whether the aim is to enhance existing products, develop new products, or develop new markets (Dankbaar, 2007); innovation capabilities, i.e., the ability of the firm to develop and commercialise innovations; Product portfolio, i.e., the diversity and scale of products within market domains; company size, indicating access to scale of resources; appetite for risk, and; the strength of the firms existing innovation portfolio.

The scale and extent of industry/market and company factors indicates the region along the innovation sourcing continuum from raw ideas to market-ready products that a firm should adopt (Nambisan and Sawhney, 2007). Firms tend to be attracted to either end of the spectrum. Firms can, however, make decisions to adjust the scale and extent of their company factors to expand in to the middle, thus increase its options and flexibility (Nambisan and Sawhney, 2007) (Chen and Yuan, 2007).

4.5.1.3 Scale of outsourcing

Firm performance is ultimately the rationale for outsourcing innovation and the key consideration when deciding how much to outsource. There is an inverted U-shaped relationship between R&D outsourcing and innovation performance (Grimpe and Kaiser, 2010) (Kotabe et al., 2008) (Rothaermel et al., 2006). There is a 'tipping-point' beyond which increasing R&D outsourcing leads to negative innovation returns on innovation performance.

Firm R&D performance is a balance of the gains achieved from outsourcing R&D and the 'pains' of the dilution of firm-specific resources, the deterioration of integrative capabilities and the high demands on management attention (Grimpe and Kaiser, 2010). Firm performance to be a balance between degrees of vertical integration and outsourcing where extremes of either can lead to poor firm performance. Too much outsourcing can lead to the hollowing out of a firm's competitive base, whilst extreme vertical integration may impact a firm's responsiveness to changing markets.

Between the two extremes of vertical integration and outsourcing lies a balance where a firm's product portfolio, product success, competitive advantage and ultimately firm performance are optimised. The threshold from which R&D outsourcing becomes negative is firm-specific and depends on the internal knowledge base of the firm. The more a firm invests in internal resource creation and integrative abilities, the higher the chance that over-outsourcing can be prevented.

Tipping-points occur at high levels of R&D outsourcing relative to total sales and firms will typically not encounter the negative effects of R&D outsourcing. Firms should continuously scrutinise R&D outsourcing activities to ensure that tipping-points aren't reached.

4.5.2 Why it should be outsourced

These are the rationale why managers outsource and form the basis of the increased performance that they expect to achieve as identified by (Howells et al., 2008) (Cass, 2007) (Piachaud, 2002). The factors are broadly differentiated according to whether the perceived outcome reduces cost or increases potential revenue.

Low cost oriented outsourcing differs from innovation oriented outsourcing not only when it comes to motives and characteristics, but also in their distinctly different effects on costs and innovation capability. It is important, therefore, to clearly distinguish among the different kinds of outsourcing strategy when discussing outsourcing effects (Bengtsson et al., 2009).

4.5.2.1 Cost reduction

Outsourcing enables efficiency gains to be secured by lowering costs (Amaral et al., 2011), especially fixed investments, and using resources more efficiently. There is some discrepancy concerning its importance as a trigger for outsourcing innovation, some surveys cite this as the most popular reason (Cass, 2007) whilst others identified it as only the third most important reason (Howells et al., 2008). A strategy adopted by firms in Western economies to lower R&D costs is to outsourcing overseas to countries in developing economies (Massini et al., 2010) (Bout et al., 2004).

An example of cost reduction as a determinant of outsourced R&D is when research projects which are not economically viable, but have scientific value are outsourced to universities by firms. The differing organisational missions of universities, allows firms to continue research projects which would otherwise have to be terminated (Lacetera, 2009).

4.5.2.2 Increasing speed to market

Outsourcing can expedite the R&D process by providing firms with ready access to skills, knowledge and infrastructure which would otherwise have to be developed in-house. This is especially crucial for firms in industries which have highly competitive markets or rapidly changing technologies.

4.5.2.3 Rapid exploitation of technology

It is difficult for firms to keep abreast of all the rapid changes in technology. Outsourcing innovation to a variety of vendors that use a disparate range of technologies enables firms to rapidly explore and exploit a range of new innovations (Quinn, 2000).

4.5.2.4 Spreading risk

Innovation is inherently a risky activity. Outsourcing enables firms to manage risk by broadening their research base without any long-term commitments (Festel et al., 2011). Unsatisfactory innovation projects can often be discontinued more easily and quicker than if they had been in-house.

4.5.2.5 Enhanced strategic focus

The outsourcing of non-core innovation activities enables firm's to concentrate their effort and resources on their key capabilities. This allows firms to continually upgrade their core competencies enabling them to sustain competitive advantage over a longer period.

4.5.2.6 Increased flexibility

Outsourcing enables firms to engage in a wider variety of smaller innovation projects without risking the large investments that may be required to develop disparate skills in-house. This is especially important for firms which undertake a large amount of exploratory research. Outsourcing also enables firms to deal with a lack of capacity when peaks of activity are encountered in the R&D process. Subcontracting non-core or ancillary activities is a tactic that firms use to improve flexibility (Medina et al., 2005).

4.5.2.7 Access to specialised knowledge

Access to additional knowledge and skills is rated highly as a reason to outsource innovation (Amaral et al., 2011) (Stanko and Calantone, 2011) (Howells et al., 2008) (Cass, 2007). Outsourcing enables firms to quickly acquire the specialised skills and knowledge that they do not possess in-house (Zhao and Calantone, 2003). This may be especially important for firms in a highly competitive environment where they do not have the time to develop the skills in-house.

4.5.2.8 Gain a window on new technologies

The broadening of the technology and knowledge base of many industries has meant that firm's are no longer able to specialise in all areas of research. Outsourcing provides firms with a 'window on science' enabling them to exploit the results of basic research faster and more effectively.

4.5.3 What is to be outsourced

The analysis to now has identified what can potentially be outsourced and the rationale for doing so. The analysis related to what *can* actually be outsourced concerns identifying, committing the necessary resources, and implementing the necessary changes to ensure the organisational structures and processes are able to support the innovation to be outsourced. A failure to put the appropriate structures in place will lead to innovation not being sustained and the re-integration of outsourced R&D (Glimstedt et al., 2010).

4.5.4 Where should it be outsourced

The default location for outsourced R&D is onshore (Amaral et al., 2011). Firms base their decisions on a narrow set of reasons, (e.g., lower 'linkage' costs and lower employee turnover). It is argued that location decisions should be made with due consideration of a comprehensive framework of factors to maximise outsourced innovation performance. Both macro and micro location factors are required to be considered in relation to the home location which may be in the Western economy or a developing economy.

4.5.4.1 Location choice - government policy

Government policy should be reviewed to identify the extent to which it supports or inhibits outsourcing R&D. A strong innovation policy encourages domestic innovation, innovation outsourcing and attracts foreign innovation investment. Firms should also assess levels of uncertainty associated with a country's political, legal, cultural and economic policies which may threaten the stability of the business environment (Demirbag and Glaister, 2010).

Successful government innovation policy is exemplified by US technological leadership in the semiconductor industry which has been developed and sustained despite a rapid increase in international flows of capital and technology (Macher et al., 2007). This is attributed to large investments made over decades to create an innovation infrastructure which is based in firms, universities and government research facilities. It is prudent for firms to assess government innovation policy, its impact on the national innovation environment and its support for innovation outsourcing.

Taiwan has become a worldwide base for many electronics products because the government has spent billions on building technology parks and heavily subsidising R&D activities (Chen and Shen, 2010).

4.5.4.2 Location choice - legal regime

R&D outsourcing location decisions should be made within the global context of legal regimes. Potential locations should have sufficient legal safeguards to protect intellectual property, (e.g., TRIPs, agreement on trade-related aspects of intellectual property rights), and have the legal structures to ensure that they are meaningfully implemented (Gervais, 2009). Location decisions should also consider the laws for the movement of information and people across companies and industries (Roy and Sivakumar, 2011).

4.5.4.3 Location choice - innovation networks

An innovation network can be considered as an aggregation of relationships between organisations and individuals who create, store and transfer the knowledge and skills which define new and improved products and services.

An efficient and effective innovation network is crucial for outsourcing R&D. Weak innovation networks discourage innovation outsourcing, whilst strong innovation networks encourage innovation outsourcing. This is evidenced by firms tending to outsource their innovation overseas rather than domestically due to a lack of an easily accessible national innovation network (Chen and Yuan, 2007). Firms are discouraged by the high transaction costs associated with trying to outsource innovation in an inadequate domestic national innovation network. The

high transaction costs are attributed to shortcomings which include: a lack of a platform for open technology transfer; the difficulty of searching for appropriate new technologies, and; a lack of authoritative intermediaries to assess the market value of technologies.

Innovation outsourcing is also impacted by the size and structure of innovation networks. (Macpherson, 2008) identifies that a growing number of firms have been outsourcing innovation at levels far in excess of those in the 1990s, aided by a dramatic increase in the scale of external linkages. A large and effective innovation network enables better innovation due to better access to necessary competencies. Participating in inter-firm networks enables access to a broader pool of resources and knowledge (Noke and Hughes, 2010). Innovation networks should be reviewed at both the national and regional level when determining outsourced R&D location.

1. National networks - The scale of national innovation networks is dependent on government policy. The opening up of the public sector to private sector involvement can significantly increase the scale of external linkages to drive innovation outsourcing for the mutual benefit of both sectors. This is occurring in both the developed Western economies as well as the developing Eastern economies. The US federal government is encouraging national laboratories to make their research available to the private sector (Gwynne, 2002), whilst Chinese science & technology outsourcing activities increased significantly between 1996 and 2002 (Motohashi and Ziao, 2007). The Chinese government drove an increase in the scale of activity linkages between Chinese public sector organisations and private firms through greater government funding and reform to create a more market-based innovation system.

   The effectiveness of government policy to support innovation outsourcing can also be determined by exploring the market size and structure (Baumann and Grupp, 2008). Imports of innovation services that is significantly higher than exports may reflect a lack of effective government support for the domestic innovation network. Foreign outsourcing of highly research-intensive innovation may reflect a lack of sufficiently large clusters with the

necessary competencies in the national innovation network. Foreign outsourcing of less research-intensive innovation may reflect a lack of local or structural capabilities, or slow and expensive services within the domestic market.

2. Regional networks - In addition to national innovation networks, political competence at the regional and local level is an important factor in designing and delivering policies to foster innovation (Rutten and Boekema, 2007). They identify and categorise three types of regional innovation network depending on their effectiveness and reach, i.e., whether the network is embedded territorially, regionally or nationally.

4.5.4.4 Location choice - access to talent

Location decisions should be guided by the size and quality of the talent pool. Access to high-quality, relatively low-cost R&D personnel enhances a firm's innovation competitiveness (Demirbag and Glaister, 2010) (Castellacci, 2010) (Lewin et al., 2009).

4.5.4.5 Location choice - innovation attributes

Firm location decisions for outsourcing innovation are influenced by the characteristics of the innovation to be outsourced: variability, inseparability, tacitness, and innovativeness (Murray et al., 2009). Highly variable innovation activities, especially services, increases the degree of monitoring or control of the outsourced activity. Inseparability is the degree to which an innovation activity can occur in a different time and space. Low inseparability increases the range of distance and time zone within which the innovation activity can occur. Tacitness refers to the teachability, complexity and codifiability of the knowledge associated with the innovation activity. Tacitness makes the codification, transfer and replication of knowledge difficult. Acquisition of tacit knowledge is made easier if the transferor and transferee are located together. Innovativeness represents the potential opportunities for firms to achieve competitive advantage. Location decisions become less important the greater the innovativeness of the activity, because firms

are willing to commit the necessary resources to overcome any locational barriers to ensure success of the outsourced innovation.

4.5.4.6 Location choice - existing capability

The choice between onshore and offshore locations for outsourced innovation is dependent on firm capability for managing in those regions. Capability is related to organisational learning and is derived from the firm's experience of a country's environment and institutions (Demirbag and Glaister, 2010). Consequently, in determining location choice firms should distinguish between the capabilities for managing onshore and offshore R&D.

4.5.4.7 Location choice - total costs/benefits

R&D outsourcing should only be undertaken when it is cost-effective (Chang et al., 2009). Cost analysis should include the hidden costs, (i.e., the non-contractual unexpected costs), related to location choice. These include specification costs, design costs, knowledge transfer costs, coordination costs and control costs (Dibbern, 2008). Location dependent 'linkage' costs include travel and secure communications (Amaral et al., 2011). Outsourcing to partners with which the outsourcing firm has a long former relation can lower location dependent relation-building costs (Rundquist, 2008).

Location costs should be reviewed against the possible location benefits including gaining access to sufficient talent, capacity and developing access to local markets (Amaral et al., 2011).

4.5.4.8 Developing capability

Developing capability for managing outsourced innovation in various locations improves a firm's flexibility for location choice and potential performance. Capability for managing in differing locations includes: coordination structures and processes, getting internal buy-in, establishing corporate offshore resource centres, sharing knowledge transfer and best practices and talent management (Massini et al., 2010).

1. Manage 'psychic' distance - Capability for managing in locations is dependent on the 'psychic' distance aspects of language, culture and business practices which reduces the efficiency of information flows. Prior experience and investment in a region reduces the psychic distance and makes the firm better able to bear the risks of outsourcing to that region. Prior knowledge is relevant for foreign business knowledge, foreign institutional knowledge, (e.g., legislation and culture), and internationalisation knowledge (Angeli and Grimaldi, 2010).

2. Adopt an evolutionary approach - The less experience that a firm has of a particular location choice, the greater its propensity to adopting an evolutionary approach to outsourcing in that location, evolving routines to cope in the new environment. This approach is confirmed by (Angeli and Grimaldi, 2010) who assert that outsourcing innovation is a bottom-up process rather than a top-down detailed planning process. Outsourcing innovation, especially overseas, involves interpreting possible matches between pre-existing means, (e.g., resources, skills and new technologies), and new ends, (e.g., international markets), in a problem-solving process.

3. Promote virtual working - An effective framework is required for effecting virtual working practices when outsourcing R&D overseas (Mattarelli and Tagliaventi, 2010). The acceptance of virtual work is facilitated when the perception of different professional identities across sites is moderated by a shared organisational identify. The acceptance of virtual work is sustained through the use of glocalised work practices. These are work processes with the aim of managing work at a distance and integrating them with local work practice. The acceptance of virtual work is promoted through managerial support which enhances cultural integration and the strategic objectives of virtual work.

4. Develop a strategy for offshoring - Outsourcing overseas is a complex capability. Firms with a strategy for outsourcing overseas understand it to those that do not have a strategy. They consider a broad range of issues, (such

as motives, risks and location characteristics). Due to their greater understanding of the complexities involved, firms with an offshoring strategy are less likely to outsource R&D overseas (Massini et al., 2010).

5. Develop a strategy for offshoring to developing countries - Firms should develop a strategy, specifically, for offshoring to developing countries (Al-Shalabi and Rundquist, 2009). R&D outsourcing processes in developing countries are less-developed than those in the developed economies. Firms in developing countries often do not have formal R&D outsourcing processes. Firms outsourcing R&D to developing countries should have an effective framework for doing so, especially to overcome any cultural obstacles.

4.5.5 To Whom should it be outsourced

Identifying to whom innovation should be outsourced involves identifying the appropriate mode of outsourcing for the innovation to be outsourced and matching it to potential providers within a provider selection framework giving due consideration to key criteria.

4.5.5.1 Mode of outsourcing

Mode of outsourcing refers to the type of relationship that a firm adopts with its partner or provider when outsourcing its innovation activity. Examples of the various modes of R&D outsourcing include: acquisition, exclusive license, strategic licenses, joint development, R&D contract, spin-outs, spin-along and open source (Baloh et al., 2008) (Chatterji, 1996) (Festel et al., 2011) (Rohrbeck et al., 2009). Technology sourcing modes are jointly determined by the technological regime, industry-specific factors and resource-based view of the firm (Chang et al., 2009).

4.5.5.2 Mode of outsourcing - strategic fit

Different innovation needs require differing modes of innovation. Consequently, firms need to make choices concerning the modes of R&D outsourcing that best fit their needs. The choice of innovation outsourcing mode is defined by (Baloh

et al., 2008) as a strategic choice within a three-dimensional space whose axes are: scope of innovation; impact on existing business strategy, and; need for customisation. The scope of innovation refers to its scale and also the resources needed to be committed. The impact of the innovation on existing strategy concerns the degree to which it affects the firm's competitive position and strength. The need for customisation refers to the necessary effort required to tailor a particular innovation or the existing firm structures for effective use in a competitive context. Innovation projects with a broad scope tend also to have a large impact on business strategy and require extensive customisation. Similarly, innovation projects with limited scope tend to have a low impact on business strategy and require less customisation.

The choice of innovation outsourcing mode is dependent on the differing levels of the three strategic factors (Baloh et al., 2008). The innovation outsourcing mode most appropriate for innovations where the three strategic factors are low is acquisition, i.e., the acquiring of innovation from external parties in exchange, usually, for monetary compensation. For innovations, where the three strategic factors are at a medium level, the most appropriate innovation outsourcing mode is a strategic alliance, i.e., where business partners engage in dynamic interplay to tap in to new knowledge. The innovation outsourcing mode most appropriate for innovations where the three strategic factors are high is open source, i.e., where ideas are exchanged via a network to enable rapid access to disparate knowledge.

4.5.5.3 Mode of outsourcing - 'closeness' of relationships

Strategic fit for the mode of outsourcing based should reflect the required 'closeness' of the relationship to meet outsourcing objectives. R&D outsourcing through collaborative arrangements has the propensity to raise firm innovation performance through new knowledge associations. In contrast, arms-length R&D outsourcing through contracts does not have the propensity to raise firm innovation performance through new knowledge associations (Lucena, 2011). Collaborative arrangements are appropriate where firms aim to maximise profits, whilst arms-length arrangements are more appropriate when firms' outsourcing objectives are to reduce cost. R&D outsourcing through collaborative R&D arrangements acts

as a complement to in-house R&D, whilst arms-length R&D outsourcing through contracts acts as a supplement to in-house R&D.

The relationship between degree of closeness of arrangements and outsourcing objectives is displayed in the three different ways that firms outsource R&D to universities through outsourcing model, sponsored research model, and joint lab model (Quan, 2010).

4.5.5.4 Identifying providers

Firms identify potential partners according to various criteria including: the type of innovation being outsourced, e.g., raw ideas, whether the partner/provider can provide access to knowledge that is sufficient to solve the problem, and existing relationships.

1. Using Intermediaries - Many firms are using innovation intermediaries to help find partners and providers when outsourcing R&D (Nambisan and Sawhney, 2007). The type of intermediary varies according to the type of innovation along the innovation continuum that they source, i.e., from raw ideas to market-ready products. Innovation intermediaries that source raw ideas are idea scouts (Meyer and Ruggles, 2002), patent brokers and licensing agents. Innovation capitalists are intermediaries that source market-ready ideas. Innovation intermediaries that source market-ready ideas are business incubators and venture capitalists.

2. Providers that are 'good enough' - Gaining access to key knowledge is often an important factor when selecting suppliers for outsourcing innovation. The criteria used by outsourcing firms when selecting outsourcing partners is for access to 'good enough' knowledge, i.e. knowledge which is sufficient to solve the problem (Rundquist and Halila, 2010). Firms rate 'good enough' knowledge higher than 'low-price' or 'world-class' knowledge as selection criteria for outsourcing partners (Rundquist, 2008). This is explained by resource-based theory where firms aim to fulfil their objectives whilst optimising their resources.

3. Using existing relationships - Firms outsourcing innovation tend to seek partners with close linkages and a former history of relations, rather than strategic resources or world-class knowledge (Rundquist, 2008). Outsourcing partners with a long former relation to the firm are often chosen due to the lower relation-building costs. Many new products are developed in conjunction with supply partners (Wagner et al., 2009) (Niezen and Weller, 2006), however, long-term supplier links do not play a role in the development of radical innovations (Perrons and Platts, 2005b). Outsourcing partners with strong inter-linkages to the firm are often chosen as partners because it makes the outsourcer less vulnerable to the leakage of knowledge. Innovation outsourcing returns are positively correlated to prior access to information about the R&D activities at target firms and a superior negotiating position (Higgins and Rodriguez, 2006).

4.5.5.5 Provider selection

The selection of suitable partners for outsourcing R&D is a key strategic consideration. Selecting partners from a large number of possible suppliers with various levels of capability and different potentials is a complex multi-criteria decision-making problem with both qualitative and quantitative factors. Project-specific partner competence distinguishes successes from failures (Cui et al., 2009). Good decision-making needs to tolerate vagueness and ambiguity. A comprehensive framework for selecting the most suitable R&D outsourcing partner is proposed by (Chen and Hung, 2010). The framework uses an integrated fuzzy approach comprising five criteria, (financial consideration, quality, service performance, compliance, and culture), and fifteen sub-criteria to address the complexity and ambiguity of real world decision-making.

Knowledge-related factors should also be considered when outsourcing innovation, including knowledge orientation and learning styles.

1. Knowledge orientation - Firms with an emphasis on outsourcing innovation value knowledge orientation higher than trust or proximity, whilst the opposite is correct for firms with a lesser emphasis on innovation outsourcing (Rundquist and Halila, 2010).

2. Learning styles - Alignment of provider learning style to the nature of the innovation being outsourced should be considered when selecting provider (Azadegan and Dooley, 2010). Knowledge complementarity is the balance between knowledge similarity and dissimilarity, i.e., 'knowledge that is both related and diverse' (Lofstrom, 2000). Valuable inter-organisational learning requires similarity to facilitate learning and sufficient knowledge dissimilarity to provide something worth learning. Complementarity between the recipient and source knowledge is a critical aspect of the knowledge absorption process and therefore of R&D outsourcing performance (Abecassis-Moedas and Mahmoud-Jouini, 2008).

   Typically, outsourcing firms tend to select providers based on similarities of knowledge bases, culture and, consequently, organisational learning styles. Firms who tend towards an exploration learning style often select suppliers who possess an exploration learning style. Similarly, firms who tend towards an exploitation learning style often select suppliers who also tend towards an exploitation learning style. This may not always be appropriate. Where providers have low innovation responsibility, the impact on firm performance is best attained when the firms have contrasting learning styles. Where providers have high innovation responsibility, the impact on firm performance is best attained when the firms have similar learning styles.

4.5.5.6 Length of relationships

Determining the optimal lifespan of an R&D outsourcing relationship is essential to its performance. The relationship between the age of R&D alliances and firm performance is investigated by (Deeds and Rothaermel, 2003). They identify that the relationship between alliance age and alliance performance is U-shaped. Alliance performance initially decreases and reaches its low point after four and half years and then improves again. It is suggested that the initial decline in alliance performance is due to the erosion of substantial goodwill with which the alliance is originally endowed. The management implications for successful R&D outsourcing are to plan for strong and long-term relationships and to suppress

any inclination to terminate relationships early without substantial reasons for doing so.

4.5.6 How should it be outsourced

Outsourcing R&D is not only about involving external resources in the development of new products. It is also and especially about developing a business model geared to the scanning and incorporation of useful knowledge produced outside the firm. It entails developing organisational structures and routines to coordinate inflows and outflows of knowledge without eroding architectural knowledge (Chesbrough, 2003).

The realisation of the benefits of disaggregating R&D from the value chain is held back by 'stickiness' arising from the configuration of firm activities (Andersson and Pedersen, 2010). Key organisational design variables of structure, procedures, culture and incentives must be aligned for an effective innovation outsourcing organisation. Firms must be willing to make the necessary resourcing decisions for changes to the firms structures to support outsourced innovation.

4.5.7 Firm structures

Outsourcing R&D requires enhanced flexibility in firm structures, systems and processes, including IT, financial processes, and employment intensity. A failure to put the appropriate structures in place will lead to innovation not being sustained and re-integration of outsourced R&D (Glimstedt et al., 2010).

4.5.7.1 Modularity

Whilst traditional management practice holds that firms should tightly couple internal activities to improve operational efficiency, the opposite holds for outsourcing innovation. Greater modularity of products/services, knowledge and organisational design is necessary to enable effective R&D outsourcing.

1. Product/Service architecture - Increased modularity of R&D products and processes aids R&D outsourcing. Modularity concerns the distinction between subsystems in a given system (Grote and Taube, 2007). It refers to

the degree of coupling between subsystems; the looser the coupling between subsystems, the greater the modularity. Modularity and modularisation is relevant to services as well as products (Baldwin and Clark, 1997).

2. Organisational architecture - Increased modularity also extends to organisational design. It is argued by (Hayashi, 2008) (Santos et al., 2006) that making business units more modular and autonomous enables increased innovation outsourcing and better firm performance. Modularity enables firms to respond to business opportunities more rapidly with improved levels of firm performance which outweigh the costs of coordinating increased activities.

3. Knowledge architecture - Knowledge partitioning should be distinguished from task partitioning in order for a firm to retain its knowledge advantage over the external business environment (Takeishi, 2002). This is not a simple activity as knowledge can be considered as a system of processes deeply rooted in their contexts of production (Paoli and Prencipe, 1999). Knowledge exchanges should be decoupled throughout the value chain (Fifarek and Veloso, 2010).

Alignment between modularity of product/service architecture, organisational architecture and knowledge architecture should be attained for outsourced innovation. Deficiencies in the degree of modularity in product architecture leads to deficiencies in the modularity of organisational architecture (Stephan et al., 2008).

Complex products are not completely decomposable (Zirpoli and Becker, 2011a). Attempting to decompose knowledge for anything other than simple systems may lead to loss of meaning and control over the outsourced activity and eventually a loss of the firm's knowledge base which confers its competitive distinctiveness (Paoli and Prencipe, 1999). Reliance on modular product architectures cannot be substituted for maintaining in-house component knowledge development. Architectural knowledge and the associated competence of making performance trade-offs are only possible if component-specific knowledge is retained (Zirpoli and Becker, 2011b).

Firms should not seek to design perfectly modular systems, but instead find ways of managing across boundaries through appropriate incentives, specifications, information systems, people and governance (Amaral et al., 2011).

4.5.7.2 Firm Flexibility - information technology

Information technology, (IT), plays an important role in enabling firm strategy; in particular, positively impacting R&D outsourcing (Barczak et al., 2008) (Hempell and Zwick, 2008). IT usage in R&D outsourcing positively impacts both speed to market of innovations and market performance in terms of meeting expectations with regards to sales, market share, profitability and customer satisfaction (Barczak et al., 2008). It is suggested, however, that the consequence of IT usage is context specific as its impact differs depending on the size of teams.

The mechanism by which IT usage aids R&D outsourcing is by enhancing firm flexibility through reduced communication and transaction costs within and between firms (Hempell and Zwick, 2008). Flexibility is defined in terms of employee flexibility and organisational flexibility. Employee flexibility is realised through empowering the existing workforce's ability to participate in varying capacities - greater decision-making responsibility and increasing the scope of participation in diverse activities. Organisational flexibility is realised by making the firm boundaries more permeable enabling outsourcing which has the potential to reduce costs and externalise risks. Intensive IT usage and investment increase both employee flexibility and organisational flexibility, enhancing communication and leading to better product and process innovation performance.

IT usage has the potential to facilitate better communication and cooperation between teams engaged on outsourced R&D, especially if they are globally dispersed. However, the positive effects of IT usage on outsourced R&D are unlikely to be fully realised unless IT is embedded within formalised R&D outsourcing processes (Barczak et al., 2008). This is echoed by (Hempell and Zwick, 2008) who affirm that firm performance through investment in IT training and appropriate IT infrastructure is only realised if accompanied with organisational changes

4.5.7.3 Firm Flexibility - finance

Flexible finance procedures are required to support the uncertainty inherent in outsourced innovation. This is especially so with respect to the commercialisation of innovations within agreements. A value-based approach to R&D agreements is proposed by (Wouters, 2010). Value within agreements is based on two factors; firstly, the cost savings that can be achieved by the acquirer in using the technology to improve processes, and secondly, the higher revenues generated in improving products and services to customers. Using a value-based approach to agreements aids a shared understanding between outsourcing firms and suppliers.

Firms should review internal R&D investment depending on the mode of outsourcing innovation activity (Tsai and Wang, 2009). Internal R&D investment negatively impacts firm performance when innovation activity is outsourced to substitute existing innovation activity. Internal R&D investment positively impacts firm performance when innovation activity is outsourced to complement existing innovation activity through, for example, collaboration. Internal R&D investment not only contributes significantly to a firm's innovation performance, but also enhances the effectiveness of collaboration with different partners. Internal R&D investment stimulates innovation and strengthens absorptive capacity to enhance technology acquisition.

4.5.7.4 Firm Flexibility - employee

Firms' strategy for outsourcing R&D determines changes in their internal R&D employment intensity (Teirlinck et al., 2010). R&D employment intensity of firms changes depending on the strategic decisions to start, increase, decrease or stop outsourcing. Internal R&D employment intensity decreases when firms decide to start, increase, or stop R&D outsourcing. The decrease in internal R&D employment intensity when starting or increasing R&D outsourcing implies that R&D outsourcing is driven by a lack of in-house R&D and technical expertise. The decrease in internal R&D employment intensity when stopping R&D outsourcing implies that R&D outsourcing is directed towards discrete projects and supports the complementary nature of R&D outsourcing.

4.5.8 Governance & control

Governance and control concerns accessing, exploiting and defending intellectual property, (IP), in outsourcing relationships. A conceptual framework for understanding the management of IP in outsource knowledge-based services is developed by (Roy and Sivakumar, 2011). The core elements of the framework leverages buyer-seller relationship factors, (i.e., trust, and control/verification) for the management, (i.e., accessing, exploiting and defending), of IP to achieve the generation of innovation, (i.e., incremental or radical), as a consequence.

The framework is broadened to include globalisation factors (i.e., multiple-tiers, legal environment and supplier communities of practice). Firms should include international standards, e.g. TRIPs(agreement on trade-related aspects of intellectual property rights), within contracts for IP protection (Sener and Zhao, 2009) (Gervais, 2009), and ensure that countries can be meaningfully implemented in the countries where innovation is to be outsourced.

The central issue in R&D outsourcing is the risk of IP leakage and subsequent erosion of competitive advantage. The risk of IP leakage prevents R&D being outsourced even though it is economically efficient to do so. Any decision to outsource R&D should involve valuing the potential loss of any IP leakage (Lai et al., 2009). Outsourcing R&D may be the correct decision despite knowing that leakage will occur. Retaining R&D in-house is the correct decision if both the firm's loss and suppliers gain from IP leakage is large. Outsourcing with revenue sharing is the correct decision when the supplier's gain from IP leakage is small, and the firm's loss from IP leakage is neither too large nor too small.

4.5.8.1 Formal control

Contracts form the basis of most innovation outsourcing relationships. A model for their management is proposed by (Fitzpatrick and DiLullo, 2005) comprising: effective partner screening, pre-partnership negotiations, partnership structuring activities, contract administration, and the monitoring of alliance partners after contract termination. Whilst, forming the foundation of any relationship, it is acknowledged that contracts can never be complete and the most critical step in formulating any agreement is screening and due diligence to identify potential

partners which have a record of honouring their responsibilities. Tight legal contracts are essential for minimising any risks of knowledge leakage (Hoecht and Trott, 2006).

The uncertainty inherent within outsourcing innovation poses a problem as to how agreements should be structured between outsourcing firms and suppliers. Contract agreements should have transparent indicators of progress in the form of deliverables and milestones. They should be used to establish dialogue and jointly identify potential problems and solutions. Agreements should not be used to hold hostage providers or partners (Kleyn et al., 2007). Uncertainty can be addressed by building flexibility conferred by real options reasoning into contracts (Wouters, 2010). Real options reasoning involves breaking down investment decisions in to smaller decisions, and making investments in phases as new information becomes available.

The use of international standards, (e.g., TRIPs), within outsourced innovation contracts generates coordination efficiencies increasing the speed of development for new products and services (Blind et al., 2010).

The emphasis on formal contracts is most appropriate for relationships where the type of innovation is incremental and the type knowledge exchanged between partners is explicit (Li et al., 2008). Although formal contracts aid control in outsourcing relationships where the type of innovation is incremental, they may limit radical innovation.

4.5.8.2 Informal control

Informal or social control refers to the non-legal or non-contractual influence that an outsourcing firm can leverage in the management of outsourced innovation. The emphasis on social control is most appropriate for relationships where the type of innovation is radical and the type of knowledge exchanged between partners is tacit (Li et al., 2008). Social control benefits outsourcing relationships where the type of innovation is radical, however, it may limit incremental innovation. In countries where the legal system is less mature it is suggested that both formal control and social control be employed in equal measure.

1. Trust relationships - Trust is a key component for successful innovation outsourcing relationships (Plewa and Quester, 2006). A positive connection between trust-based governance and performance in innovation outsourcing relationships is identified by (Carson et al., 2003). They posit that effective trust-based governance is dependent on the ability of outsourcing partners to 'read' and learn from each other's behaviour. The effect of trust-based governance on task performance increases as the level of skills increase and the skills become more teachable.

2. Peripheral knowledge - Peripheral knowledge is specialised knowledge in the domain of outsourced activities. Continuing to invest in innovation of outsourced activities enhances peripheral knowledge which is used as a governance mechanism for outsourcing partners and vendors (Tiwana and Keil, 2007). Peripheral knowledge complements outcomes-based formal control, but not process-based control.

3. Modularisation - The degree of process and product modularisation brings about a conflict in the notions of greater collaboration and arms-length control between the outsourcing firm and external provider (Howard and Squire, 2007). Modularisation leads to greater collaboration with external partners and potentially an increased risk of information leakage. Innovation outsourcing relationships are moderated by relationship-specific aspects such as the degree of information sharing.

4. Interaction - The elements of interaction and control within outsourcing contracts may have contradictory implications for the management of IP (Roy and Sivakumar, 2011). Increased interaction benefits knowledge access but also makes the firm vulnerable to knowledge leakage and defending its IP position.

4.5.8.3 Novel control mechanisms

Novel control mechanisms are also identified within the literature.

1. Two suppliers - An information leakage free mechanism is proposed by (Ho, 2009) based on the theory of contract with collusion. A competitive mechanism of outsourcing R&D to two suppliers with a disclosure punishment reduces the possibility of successful leakage. Where one supplier leaks information to a buyer, it is in the interests of the other supplier to flag this to the outsourcing firm so that the other supplier has to bear the disclosure punishment. The buyer will only buy the leaked R&D innovation from one supplier to minimise its costs.

2. Brand equity - Firms outsourcing R&D could also make use of brand equity to safeguard themselves from the threat of potential market entry by their outsourcing suppliers when the outsourced component is a core competence (Lim and Tan, 2009). Brand equity is a form of market power and can be used by firms either as a deterrent against possible market entry by a supplier or to insulate themselves from the supplier's attempt to copy its position in the market place.

4.5.9 Organisational culture

Organisational culture refers to the values and beliefs of the organisation and how they impact the ability to manage outsourced innovation (Smith et al., 2008). Organisational culture for traditional innovation differs to that for outsourced innovation. Appropriate changes to organisational culture must be developed for effective performance of outsourced innovation. Establishing a culture open to and willing to engage with external parties is essential to the success of an outsourced innovation strategy (Munsch, 2004). Outsourcing innovation requires innovators to be more extrovert and to be comfortable with collaboration (Huston and Sakkab, 2007).

4.5.9.1 Absorptive capacity

Absorptive capacity is the ability of a firm to learn new knowledge and quickly apply it within the firm (Rothaermel et al., 2006). The lack of organisational culture to support outsourced innovation hinders a firm's ability to integrate effectively innovation knowledge acquired from outside its boundaries.

4.5.9.2 Subcultures

Different R&D subcultures within firms require a different approach to support them being open (Mortara et al., 2010). The subcultures are defined by the type of research being undertaken, e.g., blue sky research or applied research.

Blue sky research units tend to be scientists rather than technologists. They are motivated by collaborating with other individuals who have a similar interest and appreciate access to new stimuli. Applied R&D units focus their efforts on technologies that are linked to products and markets. They are structured and organised in project teams with defined deadlines, budgets and targets. They reflect the characteristics of an achievement culture.

4.5.9.3 Resistance

Resistance to change indicators include, e.g.: fear of job losses or a shift in power; thinking in terms of projects rather than portfolios of innovation; aversion to taking risks.

4.5.9.4 Leadership and capability development

Firms who successfully outsource innovation use individuals to champion and support R&D outsourcing initiatives (Kleyn et al., 2007). Characteristics sought are passion, commitment, competence, authority and demonstrable communication skills. These firms also develop specialist cross-functional teams with capabilities for facilitating partnering, managing intellectual property, negotiating contracts, managing projects, etc.

4.5.9.5 Actions

General actions to encourage outsourcing R&D are to: convey a positive image by giving practical examples of R&D outsourcing successes; take over the unsatisfactory parts of outsourcing R&D such as contract negotiation and IP assessment; provide missing skills such as market intelligence or legal support.

For blue sky research units it is recommended that services are provided which leverage the scientist's motivation for researching by setting up an environment

for interaction with external organisations and reducing barriers and obstacles of the more mundane tasks of external interactions.

For applied R&D units, it is recommended that technologists are encouraged by setting up specific targets for cooperation with the external organisations and show the benefits of an R&D outsourcing approach by demonstrating its strong problem solving potential. Reduce budgets and set up constraints to induce a stronger outsourcing of research.

Incentives and employment contracts differ for staff engaged on outsourced R&D projects (Zenger and Lazzarini, 2004) (Farris and Cordero, 2002).

4.6 How firms operate day-to-day

How firms operate day-to-day concerns their routines and consequent structures and procedures. Once the boundary has been defined, it needs to be spanned effectively so that both parties can coordinate the work effectively (Amaral et al., 2011). The intangibility of outsourced innovation exacerbates the potential for conflicts between firms and partners/providers (Miozzo and Grimshaw, 2005).

Planning for spanning boundaries includes: firms not seeking to design perfectly modular systems, but instead finding ways of managing across boundaries through appropriate incentives, specifications, information systems, people and governance. Comprehensive system protocols need to be put in place based on gate approval for stages of development (Jones et al., 2003).

4.6.1 Managing through projects

Project management skills specific to technology development with external providers are required for effective outsourcing of R&D (Cui et al., 2009) (Holden and Konishi, 2000). Skills that drive success in outsourced R&D relationships are: trust and communication; strong project-related partner competence; clear problem definition, and; aligning incentives and mitigating conflicts of interest. Project management techniques should be used to facilitate interaction with clients during the realisation of the activities and ensure the respect of certain requirements in terms of quality, timing and costs (Chiesa et al., 2004).

Some management skills required for successful R&D outsourcing are specific to the mode of outsourcing. Detailed process control, and actively ensuring knowledge transfer is important for success when outsourcing R&D to universities. Expectation management and organisational stability is required when developing technology with customers. When outsourcing R&D to suppliers: detailed process control; clear milestones; actively ensuring knowledge transfer, and; IP protection is required for successful relationships. In technology development relationships with competitors, IP protection and incentive alignment are important factors. Outsourcing R&D relationships with start-ups are enhanced by emphasising flexible decision making; active participation in management, and; organisational stability. Project managers are required to be assessed for specific skills which should be aligned to projects with a specific mode of outsourcing.

use of project management techniques that facilitate interaction with clients during the realisation of the activities and ensure the respect of certain requirements in terms of quality, timing and costs; making communication more effective can also improve interaction with clients

4.6.2 Managing knowledge

Many organisations outsource on a simplistic understanding of knowledge and its role in the success of a firm. These firms tend to view knowledge as information where processes are easily decomposed and outsourcing is based solely on economic factors. The alternative view considers knowledge as an evolutionary system embedded in the contexts of production. This view holds that knowledge is not always perfectly explicit, decomposable, transferable, absorbed, nor distinguishable from the product.

It is argued by (Paoli and Prencipe, 1999) that process knowledge and innovative labour is decomposable only for the very simplest of systems. Attempting to decompose process knowledge for anything other than simple systems may lead to loss of meaning and control over the outsourced activity and eventually a loss of the firm's knowledge base which confers its competitive distinctiveness.

To overcome this dilemma, (Paoli and Prencipe, 1999) state the crucial role of systems integrators within a firm who are required to achieve a detailed level of

understanding of multiple interacting disciplines. They cite the example of Rolls-Royce who successfully maintains a large range of external agreements both in terms of activity and scope for the development of aero-engines.

In complex products, component-specific knowledge is crucial to architectural knowledge as it plays an essential role in determining the overall performance of the product; it is an essential building-block that complements and strengthens architectural knowledge (Zirpoli and Becker, 2011b).

Firms need to maintain control over activities that are highly interdependent with technologies that impact on the performance of the overall product. The erosion of component-specific knowledge leads to the loss of capability to make performance trade-offs regarding performance of the product as a whole. Architectural knowledge and the associated competence of making performance trade-offs are only possible if component-specific knowledge is retained in-house.

The criteria that firms need to use when deciding what activities to keep in-house are those that have: a direct impact on key product performance, and; a high degree of reciprocal interdependency with technologies that determine overall product performance.

Performance integration must be recognised as a critical organisational task that is built in to the structure of the firm.

4.6.3 Managing learning

This concerns the ability of an organisation to review and build upon particular experiences and internalise those routines that are most effective.

Innovation services are often intangible which involve a reciprocal interacting process of knowledge transfer and learning. The intangibility of knowledge-intensive services exacerbates the tensions between the outsourcing firm and provider (Miozzo and Grimshaw, 2005). It is suggested that particular attention needs to be paid to the interface between the outsourcing firm and provider; in particular the mechanisms for reconciling conflicting interests and integrating knowledge.

Knowledge complementarity on its own is not enough to make absorption work. The combination of new knowledge, (e.g., design knowledge), with prior

knowledge, (e.g., marketing or technological knowledge) is required for R&D outsourcing performance (Abecassis-Moedas and Mahmoud-Jouini, 2008).

Inter-firm learning should be a key aspect of any outsourcing relationship. Encouraging learning by failure form one project cultivates closer cooperation between outsourcer and vendor (Mikkola, 2003). It enables searching for the best technological solutions for future projects.

An R&D outsourced business model must maintain and enhance an organisation's ability to absorb and diffuse knowledge form external organisations and retain architectural knowledge (Ciravegna and Maielli, 2011). Outsourcing R&D can have negative effects on firm performance if it leads to an erosion of architectural knowledge, and if they fail to develop mechanisms to absorb and integrate knowledge from suppliers.

For firms that outsource R&D of complex products it is important to retain both architectural knowledge and component-specific knowledge. Firms cannot develop sufficient architectural knowledge independently from investment in component-specific knowledge (Zirpoli and Becker, 2011a). Component-specific knowledge is best acquired by being immersed in the details of component development - learning by doing. Co-location of engineers encourages communication and collaboration and knowledge transfer early in the development cycle. However, this is often insufficient. It is necessary to work hands-on alongside suppliers rather than acting as supervisors.

4.6.4 Managing proximity

Proximity matters in outsourced R&D (Cusmano et al., 2009). Proximity refers to the 'closeness' between the outsourcing firm and provider. It is relevant for the communication of complex information and knowledge, where close proximity provides for more efficient and effective knowledge exchange. Much of the literature refers to geographical proximity, e.g., (Baumann and Grupp, 2008) referring to the distance in miles or kilometres between the outsourcing firm and provider. As the distance between the outsourcing firm and provider increases, the potential for difficulty in communicating complex knowledge also increases.

Consequently, implementing effective structures for managing the flow of information also become more important. The unmanaged loss of proximity when outsourcing has detrimental implications for the long-term competitiveness of the firm (Dankbaar, 2007).

Geographical proximity is but one form of proximity. Different kinds of proximity are required for the effective and efficient communication of complex knowledge: spatial, organisational, cultural and professional (Grote and Taube, 2007).

1. Spatial proximity: Face-to-face contact provides for 'verbal, physical, contextual, intentional and non-intentional' communication (Storper and Venables, 2004). Spatial proximity is most important when there is a need for spontaneous and informal contact, and the development of trust.

2. Cultural proximity: The diversity of environments acts as an inhibitor in the exchange of information and knowledge. In the outsourcing of innovation between partners of differing nations, there is often a need to understand differing languages, business practices and regulations.

3. Organisational proximity: This refers to firm-specific information and the manner in which it is handled, e.g., corporate identity, philosophy and rules (Blanc and Sierra, 1999). It is prevalent throughout the organisation despite differing geographical locations.

4. Professional proximity: This concerns the understanding between individuals of aims and methods, i.e., their professional language. Creating a shared identity between the firm and provider/partner helps bridge any gaps in professional proximity (Mattarelli and Tagliaventi, 2010).

4.6.5 Managing contracts

In addition to tight legal contracts, other measures can be taken by managers to minimise any risk of knowledge leakage (Hoecht and Trott, 2006): the partner/provider may control their own behaviour if they fear losing repeat business; the outsourcing firm may acquire a stake in the partner/provider; the firm may recruit individuals in to partner/provider sites with access to senior management

- these 'boundary spanners' have an overwhelming interest in guarding their reputation as trustworthy and competent.

Confidentiality and data ownership become important issues as information and knowledge flows across firm boundaries (Festel et al., 2011).

4.6.6 Managing relationships

Clear specifications to describe how interactions should occur across the boundary should form the foundation of managing relationships with partners/providers (Amaral et al., 2011).

Trust, commitment and championship are key components for successful innovation outsourcing relationships (Staniuliene, 2009) (Plewa and Quester, 2006). Trust is a fundamental construct which correlates positively to commitment and partner satisfaction. Commitment is defined, both in terms of effort in maintaining the relationship, (i.e., contribution), and also loyalty to the relationship, (i.e., attachment). The use of championship also engenders trust, commitment and satisfaction, by appealing directly to individual's motivations.

Capabilities within relationships that facilitate innovation are robust bi-directional information flows and learning processes centred on relationships (Weeks, 2009).

4.6.7 Managing performance

A framework for measuring supplier performance when outsourcing R&D in a collaborative setting is proposed by (Dain et al., 2011). The framework identifies the four main areas of performance: product, process, project, and relationship. Evaluation of supplier performance in these areas is measured throughout the three project stages: concept feasibility & concept design; product & process design; industrialisation & product/process validation.

Outsourced partners/vendors need to be treated almost like a virtual department with continual checks needed to be set up to monitor the progress and quality of output (Kumar and Snavely, 2004).

4.6.8 Managing people

Firms that are successful in outsourcing R&D create implementation teams which support R&D units in being more open (Mortara et al., 2010). They are small teams led by senior R&D managers. These managers tend to be visionary leaders supported by a wider team. They have a strong technical background and business mindset with a deep understanding of the company. They champion outsourcing R&D and provide a link with other company functions that support R&D outsourcing. They provide training, links with groups and facilitate access to tools.

A supporting mechanism for managing people is the use of human value chain integrators to cope with the inevitable gaps in specifications, and to resolve minor disputes (Amaral et al., 2011).

4.6.9 Managing inter-firm structures

It is important to build symmetric information sharing capabilities and network-wide process standards (Wareham et al., 2005). Inter-firm modularity and supplier ignorance are complements (Tiwana, 2008). Increased modularity lowers the need for inter-firm knowledge sharing, (i.e., increases supplier ignorance) in knowledge intensive alliances. Outsourcing R&D arrangements creates a tension between outsourcers and suppliers between sharing enough private knowledge to successfully complete alliance goals and simultaneously safeguarding it against misappropriation. Increasing modularity at the project level complements lowers the need for inter-firm knowledge sharing. Modularisation encapsulates the outsourcer's private knowledge and acts as a knowledge protection mechanism in alliances, aiding alliance governance and scope reduction.

Shared information systems should be used to collaborate with partners and to synchronise data (Amaral et al., 2011). IT usage within the context of R&D outsourcing enhances communication within and between firms (Barczak et al., 2008).

4.7 Summary

This chapter has inductively developed an archetype framework for successfully outsourcing innovation. Template analysis of 248 research articles, involving iterations of observation and classification, has been used to identify and organise categories of innovation outsourcing activity as a template for outsourcing innovation. The framework is formed through interpretation of the template as an archetype for successfully outsourcing innovation.

Chapter 5

Model Development and Visualisation

This chapter addresses research objective 2(b), to 'develop a preliminary innovation outsourcing model by exploring the framework to identify the associations between capabilities and performance'. An overview of the chapter is displayed in Fig. 5.1.

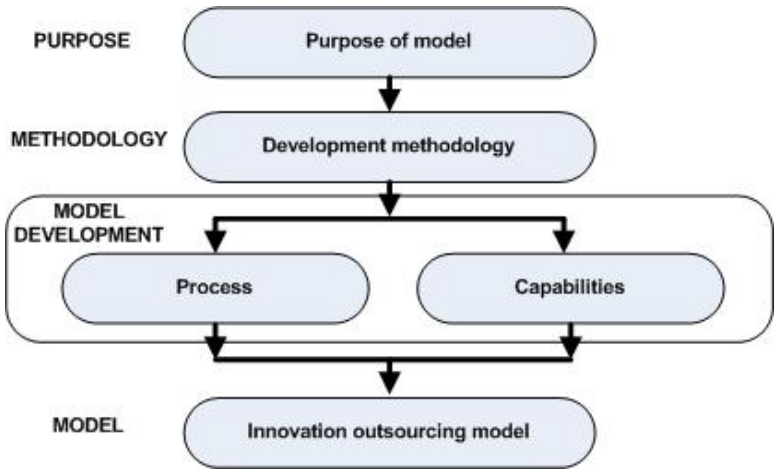


Figure 5.1: Overview of development of innovation outsourcing model

The preliminary innovation outsourcing model is developed through exploration of the innovation outsourcing framework from the previous chapter using

influence diagrams. Exploration of the framework involves the identification of two types of association between innovation outsourcing phenomena and performance. These are, firstly, the relationships between the ordering and organisation of innovation outsourcing capabilities and performance, i.e., process, and; secondly, the relationships between the attributes of innovation outsourcing capabilities and performance. The model comprises a set of propositions relating aspects of innovation outsourcing to performance.

As a qualitative study, particular attention is paid to research quality through detailed description and justification of the options and techniques employed.

5.1 Purpose of model

The preliminary model is inductively developed as a set of propositions which relate innovation outsourcing process and capabilities to performance. Its development represents the third step of the inductive stage of the descriptive theory-building phase of this study. This is illustrated as the shaded segment in Fig. 5.2.

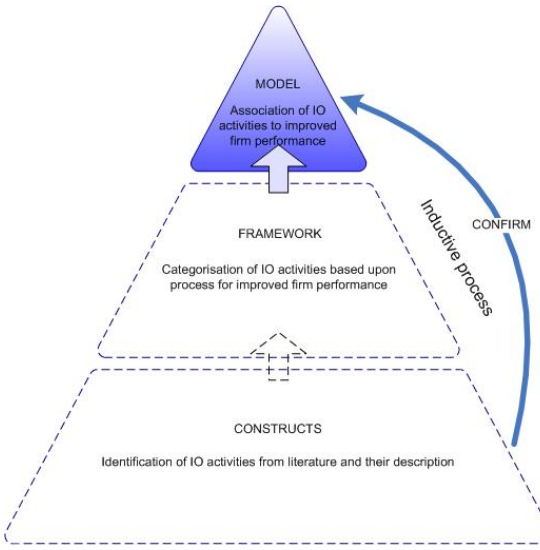


Figure 5.2: Inductive development of innovation outsourcing model

Its purpose as a *preliminary* model is to serve as a starting point for validating and improving innovation outsourcing theory relating to the research sub-question. 'What are the capabilities associated with successfully outsourcing innovation, and how should they be organised to realise performance'?

In subsequent chapters of this thesis document, the model is validated and refined by exploring whether the outcomes as identified by the propositions also exist in a different set of data. If the data matches the propositions, the model is verified. Where the data does not match the propositions, there is an opportunity to enhance innovation outsourcing theory and the model. The attributes that define the innovation outsourcing constructs, framework and model are reviewed to identify whether better definition or categorisation can explain the anomaly.

5.2 Model development

The development of an innovation outsourcing model involves using the innovation outsourcing framework developed in the previous chapter to explore the association between the attributes of innovation outsourcing phenomena and observed outcomes. The differences in attributes and how they correlate to patterns in outcomes are made explicit (Christensen, 2006). The result at the end of this final step of the inductive stage of theory building is a preliminary holistic model of innovation outsourcing.

Performance, as the eventual outcome of interest, is clarified prior to modelling the innovation outsourcing process and its constituent elements.

5.2.1 Performance

Performance is the outcome of creating value and, ultimately, the rationale for outsourcing innovation. Value creation is achieved through identifying the benefits associated with innovation outsourcing and ensuring that they outweigh the costs involved in its implementation. This is illustrated in Fig. 5.3.

Benefits: Firms outsource innovation for the expected benefits. There exist various benefits of innovation outsourcing which are identified within the 'Why

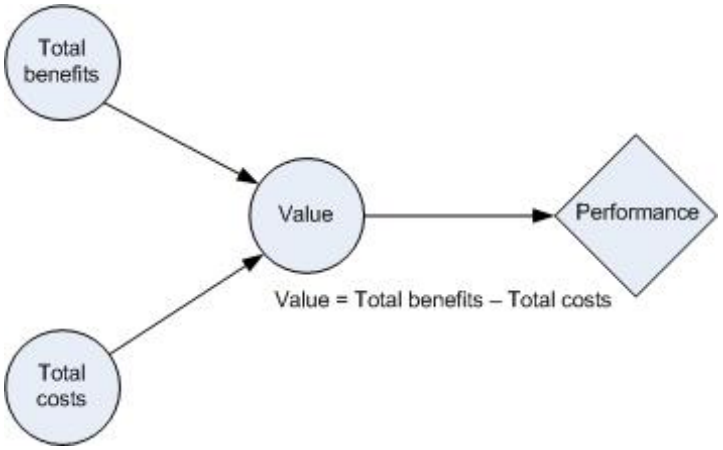


Figure 5.3: Firm performance and value creation

particular innovation activity should be outsourced' category of the framework (Amaral et al., 2011) (Bengtsson et al., 2009) (Howells et al., 2008) (Piachaud, 2002). These benefits are summarised as:

- *Cost reduction* - lowering fixed costs and using resources more efficiently.
- *Increased speed to market* - access to skills, knowledge and infrastructure which would otherwise have to be developed within the firm.
- *Rapid exploitation of technology* - enables the rapid exploitation of disparate new technologies.
- *Spreading risk* - broadening of research base without long-term commitments.
- *Enhanced strategic focus* - outsourcing of non-core innovation activities so that effort and resources can be focused on key capabilities.
- *Increased flexibility* - participation in a broad range of innovation activities without having to develop disparate skills.
- *Access to specialised knowledge* - the acquisition of specialised skills and knowledge for which there is no time to develop within the firm.

- *Gain a window on new technologies* - enables the fast exploitation of new basic research.

The theoretical basis behind a firm's rationale for outsourcing innovation is the concept of utility. Utility theory asserts that products or services are not procured for their own sake, but for their expected benefits (Lancaster, 1971).

Costs: The costs involved in outsourcing innovation are those associated with developing the capabilities for managing its risks and ensuring that its benefits are fully realised. The capabilities, and consequently the costs, exist throughout the innovation outsourcing process. They are identified within each of the framework categories later in this chapter.

Value: The value of innovation outsourcing is determined by the utility of benefits less the total costs of achieving the delivered benefits. Despite the various ways in which the benefits of innovation outsourcing are described, value can only be increased in one of two ways, increasing profits or reducing costs (Ravald and Groonroos, 1996):

- Increasing profits - this is achieved by increasing the benefits, i.e., by adding something that is perceived by the customer as important, beneficial or unique.
- Reducing costs - this is achieved by reducing the sacrifice, e.g., through lower cost or greater convenience.

Increasing benefits or reducing the sacrifice are mutually reinforcing. Increasing benefits should lead to a reduction in sacrifice.

Managing the realisation of innovation outsourcing performance is asserted as:

P-P1 *Performance through innovation outsourcing is managed by ensuring the total utility of benefits outweigh the costs of achieving the delivered benefits.*

5.2.2 Decision process

An overall decision process for improved performance through innovation outsourcing is derived from the innovation outsourcing framework developed in the previous chapter.

- What innovation activity can *potentially* be outsourced.
- Why particular innovation activity should be outsourced.
- What innovation activity can, *in reality*, be outsourced.
  - Where innovation should be outsourced.
  - to Whom innovation should be outsourced.
  - How innovation should be outsourced.
- How outsourced innovation is to be managed.

The innovation outsourcing framework categories stated above are organised as three process elements which act together to improve firm performance:

1. Determining innovation activity to be outsourced
2. Deploying innovation to be outsourced
3. Managing outsourced innovation

The mapping of framework categories to the three elements of the innovation outsourcing process is displayed in Fig. 5.4.

The association between innovation outsourcing process and performance is asserted as:

P-P2 *Performance through innovation outsourcing is dependent on undertaking an ordered set of activities relating to: the determination of innovation activity to be outsourced; the deployment of innovation to be outsourced, and; the management of outsourced innovation.*

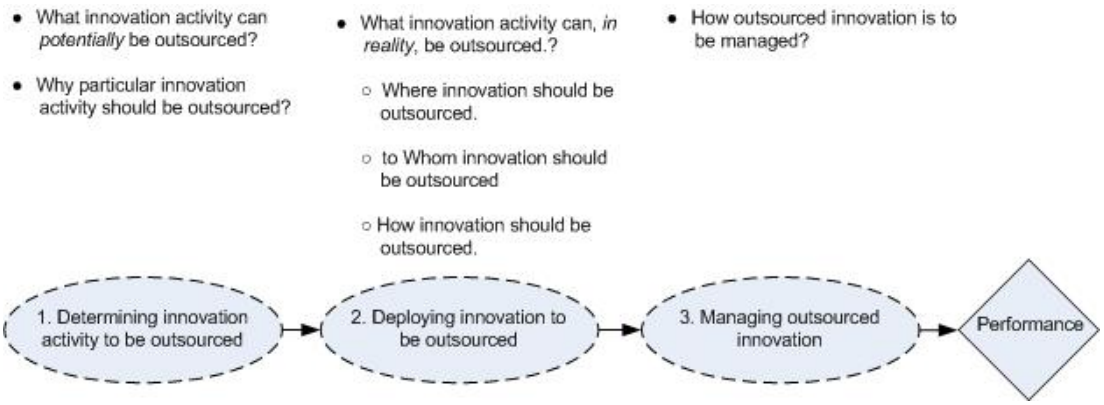


Figure 5.4: Process overview for outsourcing innovation

5.2.2.1 Determining activity to be outsourced

The process for determining innovation activity to be outsourced is illustrated in Fig. 5.5. It identifies that the effective determination of innovation activity that

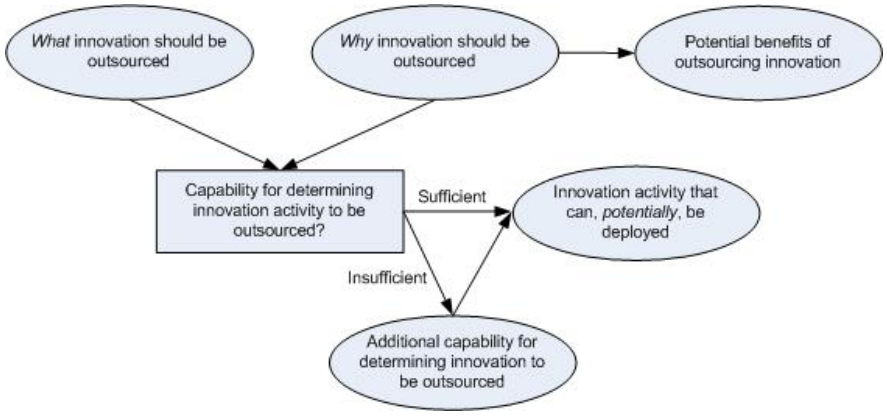


Figure 5.5: Process for determining innovation activity to be outsourced

can *potentially* be deployed is dependent on a firm's capability to identify what innovation should be outsourced and why it should be outsourced. Insufficient capability leads to suboptimal firm performance. This can be prevented through appropriate investment in developing capabilities for determining innovation activity to be outsourced.

Determining the rationale for outsourcing innovation identifies the potential benefits of outsourcing innovation.

The association between capability for determining innovation to be outsourced and performance is asserted as:

P-P3 *Performance is dependent on a firm's capability for determining what innovation should be outsourced and why it should be outsourced.*

5.2.2.2 Deploying innovation to be outsourced

The process for deploying innovation to be outsourced is illustrated in Fig. 5.6. It identifies that the determination of innovation activity that can, *potentially*, be outsourced is dependent on a firm's capability for determining where, to whom, and how innovation is outsourced. If there is insufficient capability for doing so,

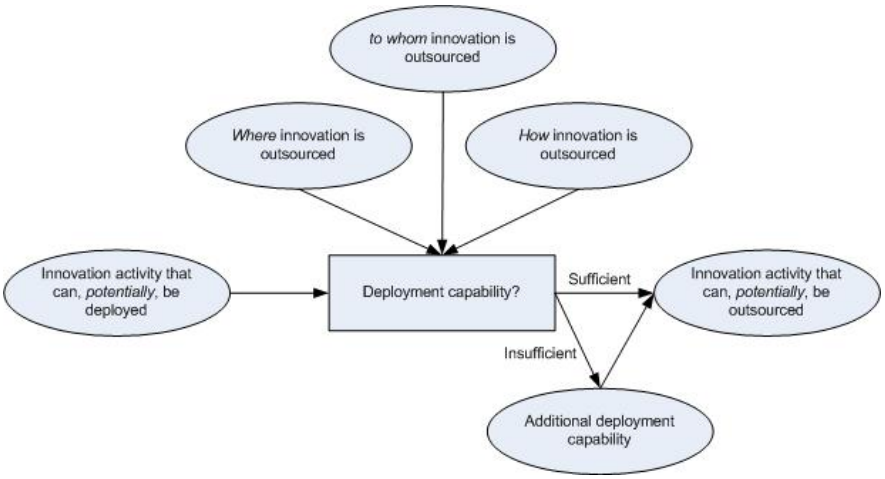


Figure 5.6: Process for deploying innovation to be outsourced

performance through innovation outsourcing is only achieved through one of two courses of action. The firm can either invest to develop sufficient deployment capability, or it can review the innovation activity that it is seeking to outsource so that it matches its existing capabilities.

The association between capability for deploying outsourced innovation and performance is asserted as:

P-P4 *Performance is dependent on the alignment of deployment capability, (i.e., the determination of where, to whom, and how innovation is outsourced), to the innovation activity being outsourced.*

5.2.2.3 Managing outsourced innovation

The process for managing outsourced innovation is illustrated in Fig. 5.7. It iden-

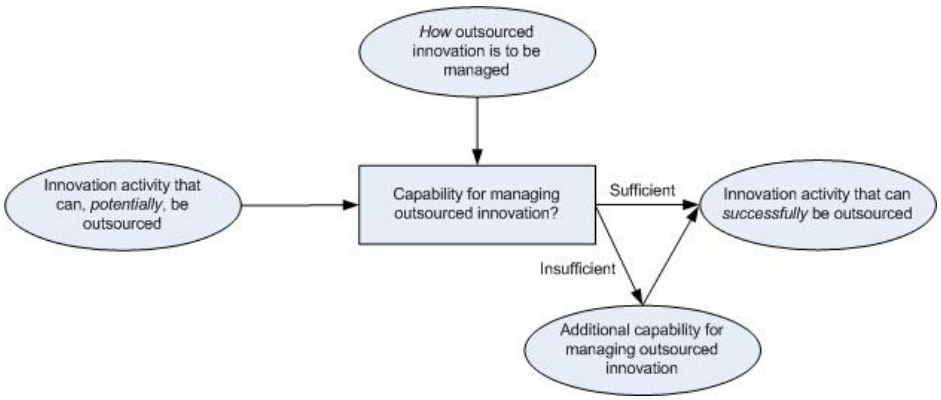


Figure 5.7: Process for managing outsourced innovation

tifies that successfully outsourced innovation is dependent on a firm's capability for managing outsourced innovation. Insufficient capability leads to suboptimal performance.

The association between capability for managing outsourced innovation and performance is asserted as:

P-P5 *Performance is dependent on a firm's capability for the day-to-day management of outsourced innovation.*

5.2.3 Capabilities investment & development

The decision to invest in the development of capabilities for outsourcing innovation is illustrated in Fig. 5.8. It identifies that the decision to outsource is

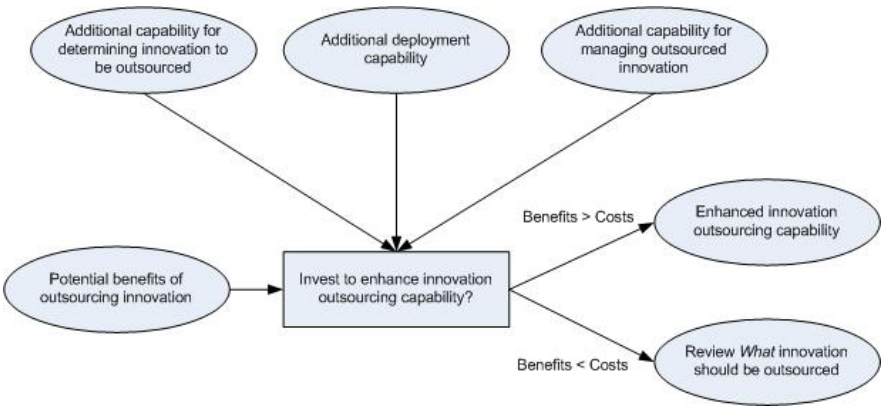


Figure 5.8: Process for investment decisions

dependent on there being sufficient existing capability to outsource innovation activity. If there is not, the decision to outsource is dependent on the benefits outweighing the additional investment required to enhance innovation outsourcing capability. The benefits of outsourcing are identified by determining why innovation should be outsourced. The costs are identified from the investment necessary for developing additional capability for determining innovation to be outsourced, deployment, and for managing outsourced innovation.

The association between capabilities investment decisions and performance is asserted as:

P-P6 *Performance is dependent on appropriate investment decisions to align innovation outsourcing capabilities to the innovation activity being outsourced.*

5.2.3.1 Portfolio approach

The process incorporates a portfolio approach to outsourcing innovation. The adoption of a portfolio approach concerns consideration of a firm's innovation

activity as a whole. It obliges a firm to review the scope of its innovation activity, define its innovation boundary, and allocate resources accordingly.

Determining the scope of a firm's innovation activity involves identifying all the innovation activity that a firm undertakes within the firm as well as outside it. Consideration of the activity as a whole enables segmentation of the innovation activity according to how significant it is to the firm against its capability relative to other organisations. In general, where the firm is more capable than other organisations the innovation activity is undertaken within the firm and where it is less capable it can potentially be outsourced. Consequently, a firm is able to determine its innovation boundary by identifying what innovation activity it should undertake within the firm and what should be outsourced. Consideration of a firm's innovation activity as a whole also enables it to identify the resources that are currently used by the firm and available to it. Resources can then be allocated appropriately according to whether the innovation activity is undertaken within the firm or outsourced. In general, a portfolio approach offers the following advantages (Cooper et al., 2001):

- Strategic alignment - ensuring innovation outsourcing efforts match the needs of the firm's overall strategy.
- Maximising value - ensuring the highest returns relative to investment.
- Balance - managing risk versus reward based on particular characteristics, (e.g., type of innovation - incremental/radical).

The association between a portfolio approach and performance is asserted as:

P-P7 *A portfolio approach to outsourcing innovation is positively associated with performance.*

5.2.3.2 Dynamic capabilities

The model encompasses a dynamic capabilities approach to outsourcing innovation. Dynamic capabilities are a "firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments"

(Teece et al., 1997). There is emphasis on the development of management capabilities and difficult-to-imitate combinations of organisational, functional and technological skills (McIvor, 2005).

The model identifies specific operating routines through which a firm systematically generates and modifies its operating routines in pursuit of improved effectiveness (Zollo and Winter, 2002). The continual identification, resourcing and development of structures and procedures throughout the innovation outsourcing process of the model ensures that the firm's capabilities are aligned to the innovation activity being outsourced.

The association between dynamic capabilities and performance is asserted as:

P-P8 *The continual identification, resourcing and development of capabilities aligned to the innovation activity being outsourced is positively associated with sustained performance.*

5.2.4 Capabilities

The broader capabilities of what, why, where, to whom, and how innovation is outsourced and managed day-to-day are further explored to identify specific capabilities and their association with performance.

5.2.4.1 What activity can *potentially* be outsourced

The specific capabilities associated with the broader capability of what innovation activity can *potentially* be outsourced are illustrated in Fig. 5.9 and detailed below:

- Differentiation of core innovation activity from non-core innovation activity.
- Determining the appropriate stage of development at which particular innovations are outsourced.

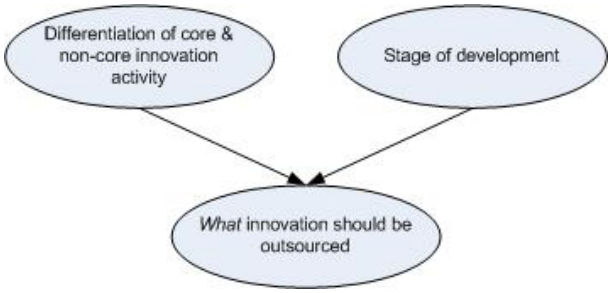


Figure 5.9: Influences on what activity can potentially be outsourced

Differentiation of core & non-core innovation activity: This concerns a firm's ability to differentiate its innovation activity according to the extent to which it is related to the core capabilities of the firm. The theoretical underpinning of this is the notion of core competencies, i.e., protecting those competencies in which a firm outperforms its competitors and which are at the core of its strategic position (Hamel and Prahalad, 1994).

Differentiation of innovation activity is not simply between core and non-core activities; there exist levels of distinction between the two extremes (Giao et al., 2008). Consequently, the granularity with which innovation activity is differentiated and the accuracy with which it is identified as core or non-core impacts the level of firm performance that can be achieved. The better a firm can differentiate its core innovation activity from its non-core activity, the better it is able to realise and maximise the benefits of outsourcing innovation activity and minimise the risks of outsourcing core innovation activity. This is asserted as:

P-C1 *Performance is dependent on the effectiveness with which innovation activities associated with core capabilities are differentiated from those associated with non-core capabilities.*

Determining the stage of development at which particular innovations are outsourced: Innovation can be outsourced anywhere along the outsourcing continuum, from raw ideas to market-ready ideas to market-ready products. The

stage of development at which a particular innovation is appropriate for outsourcing is a balance of risk & reach and speed & cost attributes that are determined from a company's internal and external (i.e., industry/market) factors (Nambisan and Sawhney, 2007).

The capability to effectively determine the optimal stage along the outsourcing continuum at which a particular innovation is outsourced provides improved firm performance through resource optimisation. If innovations are outsourced early along the outsourcing continuum, they may, for example, be subject to levels of risk greater than the company is able to bear, and consequently, lower levels of firm performance. Conversely, if innovations are outsourced late along the outsourcing continuum, they may, for example, be subject to greater cost, and consequently, lower levels of firm performance. This is asserted as:

P-C2 *Performance is dependent on the effective determination of the optimal stage along the innovation continuum at which a particular innovation is outsourced.*

5.2.4.2 Why particular activity should be outsourced

The specific capability associated with the broader capability of why particular innovation activity should be outsourced is illustrated in Fig. 5.10 and detailed below:

- Clarity of rationale for outsourcing specific innovation activity.

Clarity of rationale for outsourcing specific innovation activity: This refers to the reason why particular innovation activity is under consideration for being outsourced. It is from this that the perceived benefits, (i.e., what the firm expects by outsourcing the innovation activity), are derived. The theoretical basis behind a firm's rationale is the concept of utility. Utility theory asserts that products or services are not procured for their own sake, but for their expected benefits (Lancaster, 1971). Utility of innovation outsourcing is expressed as either improving potential profits or reducing innovation costs.

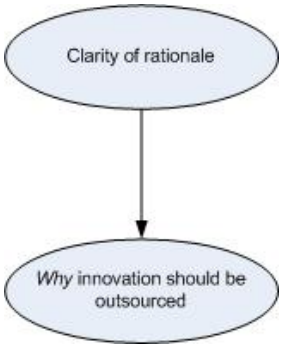


Figure 5.10: Influences on why innovation activity should be outsourced

A clear statement of utility is a key constituent of the decision to outsource innovation activity. The decision to outsource innovation is encompassed by the value concept. The value of innovation outsourcing, (i.e., improved firm performance through innovation outsourcing), is determined by the utility of benefits less the total costs of achieving the delivered benefits. Consequently, clear and unambiguous statements of utility in terms of specific, measurable, attainable, relevant and time-bound (Doran, 1981) factors contributes to improved firm performance. This is asserted as:

P-C3 *Performance is dependent on a firm's ability to determine clear and unambiguous rationales for outsourcing specific innovation activity.*

5.2.4.3 Where innovation should be outsourced

The specific capability associated with the broader capability of where innovation activity should be outsourced is illustrated in Fig. 5.11 and detailed below:

- Determining location choice of outsourced innovation.

Determining location choice: A firm's choice for outsourcing innovation is typically based on the potential benefits of the location. For example, Western economy firms may outsource innovation activity to developing economies to take

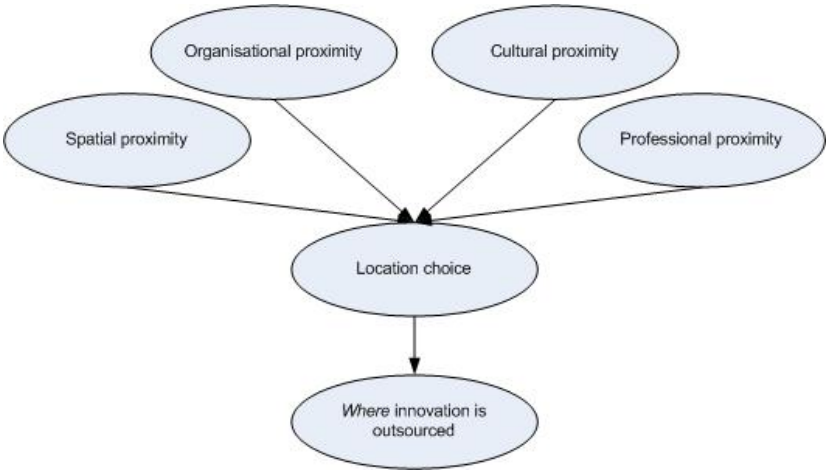


Figure 5.11: Influences on where innovation activity should be outsourced

advantage of lower innovation development costs. Similarly, firms based in developing economies may outsource innovation to Western economies to gain access to technologies for improved profit margins.

The benefits of a particular location choice are only realisable if the firm has the capability to manage the distances between itself and the choice of location for the outsourced innovation activity. Distance refers not only to spatial distance but also organisational, cultural, and professional distance (Grote and Taube, 2007). The closer the proximity of the outsourced location to the firm the simpler it is to integrate external knowledge and realise the potential of improved firm performance. This is asserted as:

P-C4 *Performance is dependent on a firm's ability to determine the level of various proximities, (i.e., spatial, organisational, cultural, and professional), associated with supplier/partner location.*

5.2.4.4 to Whom innovation should be outsourced

The specific capabilities associated with determining to whom innovation activity should be outsourced are illustrated in Fig. 5.12 and detailed below:

- Determining the mode of outsourcing.

- Developing a large and diverse pool of potential innovation outsourcing providers.
- Development of a multi-criteria innovation outsourcing provider selection framework.
- Determining length of relationship.

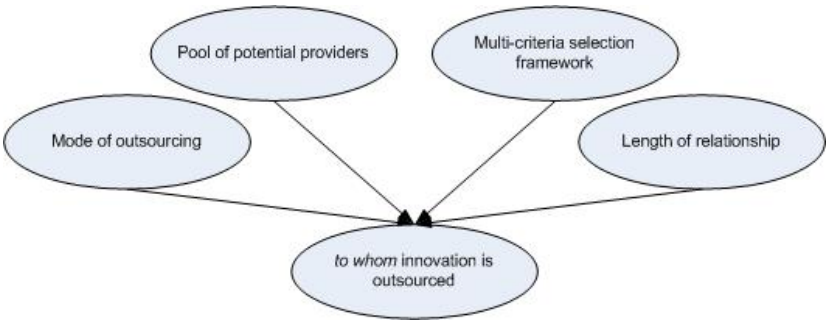


Figure 5.12: Influences on to whom innovation activity should be outsourced

Determining mode of outsourcing: Modes of outsourcing refer to the type of relationship used by a firm for outsourcing its innovation. Examples include: alliances, R&D contracts and technology licensing. Different innovation needs require differing modes of innovation. A firm's need is defined as a strategic choice within a three-dimensional space whose axes are: scope of innovation; impact on existing business strategy, and; need for customisation (Baloh et al., 2008). The selection of an innovation outsourcing mode inappropriate to the strategic needs of the firm may result in either the strategic aims of the firm not being realised or resources being wasted. This is asserted as:

P-C5 *Performance is dependent on the ability to align the mode of outsourced innovation to the firm's strategic needs.*

Determining potential innovation outsourcing providers: Differing innovation outsourcing needs require different types of outsourcing partner. For example, outsourced innovation for raw ideas requires a different type of partner to outsourced innovation for market-ready products. The greater and more diverse the number of potential partners a firm has from which to make a selection the more likely it is to identify a partner appropriate to the nature of the innovation. This is asserted as:

P-C6 *Performance is moderated by the ability to develop and maintain a large and diverse pool of potential innovation outsourcing partners/providers.*

Determining innovation outsourcing provider: Selecting partners from a large number of possible suppliers with various levels of capability and different potentials is a complex multi-criteria decision-making problem with both qualitative and quantitative factors. A comprehensive framework for selecting the most suitable innovation outsourcing partner is essential to ensuring the objectives of innovation outsourcing are achieved. This is asserted as:

P-C7 *Performance is moderated by the ability to develop and use a comprehensive multi-criteria decision-making framework for selecting the most suitable innovation outsourcing partner/provider.*

Determining length of relationship: Determining the optimal lifespan of an innovation outsourcing relationship is essential to its performance. The relationship between innovation outsourcing age and performance is U-shaped; performance initially declines, reaches a low point and then improves again. Management inclinations to terminate relationships early must be suppressed. This is asserted as:

P-C8 *Performance is moderated by the ability to determine the optimal lifespan of an innovation outsourcing relationship.*

5.2.4.5 How innovation should be outsourced

The specific capabilities associated with determining to whom innovation activity should be outsourced are illustrated in Fig. 5.13 and detailed below:

- Determining the level and alignment of modularity.
- Determining the level of flexibility.
- Determining the level and balance of governance and control.
- Determining an appropriate organisational culture.

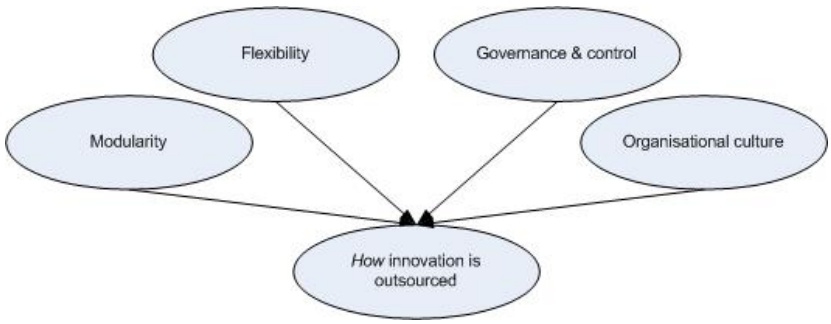


Figure 5.13: Influences on to how innovation activity is outsourced

Determining level of modularity: Greater modularity of products/services, knowledge and organisational design is necessary to enable effective innovation outsourcing. Complex systems, however, are not completely decomposable and firms should not seek to design perfectly modular systems for fear of losing meaning and control over the outsourced activity. Consequently, firm performance is dependent on a firm's ability to determine the appropriate level of product/service, knowledge and organisational modularity for the outsourced innovation activity. This is asserted as:

P-C9a *Performance is moderated by the ability to determine the appropriate level of product/service architecture modularity.*

P-C9b *Performance is moderated by the ability to determine the appropriate level of knowledge architecture modularity.*

P-C9c *Performance is moderated by the ability to determine the appropriate level of organisational design modularity.*

P-C9d *Performance is dependent by the ability to align product/service, knowledge, and organisational modularity for the outsourced innovation activity.*

Determining level of flexibility: Increased firm flexibility enables the realisation of improved performance through innovation outsourcing. Information technology, (IT), usage within innovation outsourcing enhances firm flexibility by reducing communication and transaction costs. Finance procedures appropriate to innovation outsourcing enhances firm flexibility by addressing the associated risks of uncertainty. Reviewing R&D employment intensity when starting, increasing, decreasing, or stopping outsourcing enhances firm flexibility by ensuring technical expertise is directed to where it is most needed. This is asserted as:

P-C10a *Performance is dependent on the flexibility of information technology structures.*

P-C10b *Performance is dependent on the flexibility of firm finance procedures.*

P-C10c *Performance is dependent on the flexibility of innovation employment intensity.*

Determining governance & control: The role of governance & control within innovation outsourcing relationships is to protect a firm's intellectual property, (IP), whilst ensuring that innovation objectives are realised without inhibition. This requires a balance of formal, (i.e., contractual), and informal, (i.e., non-legal), mechanisms appropriate to the nature of the innovation being outsourced. Effective governance & control requires both formal and informal mechanisms.

However, a tendency towards formal mechanisms is appropriate for incremental innovation activity, whilst a tendency towards informal mechanisms is more appropriate for more radical innovations. This is asserted as:

P-C11a *Performance is dependent on the ability to develop and use formal governance & control when outsourcing innovation.*

P-C11b *Performance is dependent on the ability to develop and use informal governance & control when outsourcing innovation.*

P-C11c *Performance is dependent on an appropriate balance of formal and informal governance & control for the innovation activity being outsourced.*

Determining organisational culture: An effective organisational culture for innovation outsourcing differs to that for traditional innovation. Furthermore, differing outsourced innovation activity requires different subcultures. The lack of an appropriate innovation outsourcing subculture constrains the absorptive capacity of the firm, (i.e. the ability to integrate effectively innovation knowledge acquired from outside the firm's boundaries), and consequently innovation outsourcing performance. This is asserted as:

P-C12 *Performance through improved absorptive capacity is dependent on the development and nurturing of subcultures appropriate to the innovation activity outsourced.*

5.2.4.6 How outsourced innovation is to be managed

The specific capabilities associated with determining how outsourced innovation is to be managed are illustrated in Fig. 5.14 and detailed below:

- Managing projects.
- Managing knowledge.
- Managing learning.

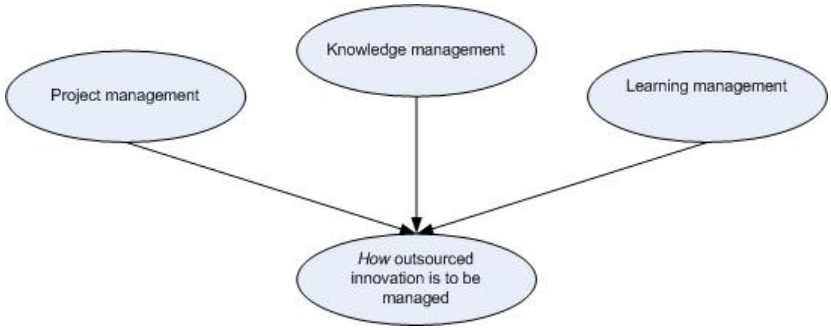


Figure 5.14: Influences on to how innovation activity is outsourced

Determining day-to-day management of outsourced innovation: This concerns the spanning of firm boundaries when outsourcing innovation, and is asserted as:

P-C13a *Performance is moderated by the ability to manage innovation outsourcing through projects.*

P-C13b *Performance is dependent on the ability to understand what constitutes knowledge and control its flow across boundaries.*

P-C13c *Performance is dependent on the ability to learn by combining new architectural and component knowledge with prior knowledge.*

5.3 Model visualisation

5.3.1 Reference model rich pictures

Rich pictures are developed of the literature worldview model which are to be used as part of an organised process of enquiry and learning.

The starting point is a description of the activity system to be modelled, i.e., the root definition. The root definition is developed using the SSM 'PQR formula', (i.e., do P, by Q in order to help achieve R).

5.3.2 Rich picture model development - SSM(p)

The grounded theory model identified in the previous chapter provides the considerations for building a model of purposeful activity, (i.e., rich picture), for investigating the outsourcing of innovation.

A logical model building process is used to build a 'defensible' purposeful activity model. The process comprises: assembling the guidelines, naming the purposeful action as a transformation, structuring activities according to their dependency, adding monitoring and control activities, and checking the mutual dependency of guidelines and model (Checkland, 2006).

5.3.2.1 Assembling guidelines

The concept underpinning the outsourcing of innovation by a firm is that it involves the holistic consideration of innovation activity to, firstly, identify that which is appropriate to be either complemented or substituted, and, subsequently, implemented across firm boundaries supported by appropriate structures and routines. The rationale is to improve the existing innovation performance of the firm.

Initial consideration may lead one to view innovation outsourcing as an activity confined to a single function, R&D, and therefore, defined as a primary task. Innovation outsourcing is a strategic decision and a concept which cuts across departments including the legal and finance functions, consequently, it is defined as issue-based.

These considerations provide the following definitions for PQR, the root definition, CATWOE and E_1, E_2, E_3 for outsourcing innovation.

PQR

- P - Outsource innovation.
- Q - by selecting innovation activity appropriate for being either complemented or supplemented and implemented across firm boundaries.
- R - contribute to improving firm innovation performance.

Root definition

- A generic firm-based system which outsources innovation by identifying innovation activity internal to the firm which is appropriate for being either complemented or supplemented, and subsequently implemented across firm boundaries, supported by appropriate firm structures and routines, to improve existing firm innovation performance.

CATWOE

- C - Senior management in the firm.
- A - R&D professionals, (i.e., scientists and technologists), project managers and R&D management support staff, (e.g., finance and legal professionals).
- T - Improving existing innovation performance through innovation outsourcing.
- W - A firm-based holistic view of innovation outsourcing derived from a systematic review of academic literature.
- O - Senior management in the firm.
- E - External, internal and cognitive factors relevant to innovation outsourcing set the environmental context. One or more of these factors may act as stimuli for considering the outsourcing of innovation, (e.g., increasing globalisation, increasing race for talent, declining productivity, openness).

E_1, E_2, E_3

- E_1 (Efficacy) - Existing internal innovation activity identified as being appropriate for outsourcing being undertaken outside the firm's boundaries with appropriate firm support structures and routines.
- E_2 (Efficiency) - Judgement by senior management in the firm that the investment decisions for outsourcing innovation are worthwhile.

- E_3 (Effectiveness) - Improved firm innovation performance, using key performance indicators, which can be directly attributed to the outsourcing of innovation.

5.3.2.2 Purposeful action as transformation

The logical process of model building proceeds the assembling of guidelines, (i.e., PQR, CATWOE, etc.).

Starting with the transformation process, 'T', and worldview, 'W', the purposeful action is named as a transformation. The purposeful action is to transform existing innovation performance, through a holistic firm-based innovation outsourcing process derived from the extant literature, to an improved innovation performance.

The model is started with three entities: the entity to be transformed, the transformation process, and the initial entity in the transformed state. The entity to be transformed is 'existing innovation performance', the transforming process is 'innovation outsourcing', and the entity in a transformed state is 'improved innovation performance'. Arrows are added to show the direction of the process and the dependency of the entities.

The 'innovation outsourcing' transformation process is dependent on the environmental context in which it operates. It is influenced and guided by one or more factors external to the firm, internal to the firm and cognitive factors. The entity displaying these environmental constraints is added to the model with arrows displaying the dependency of the transformation process on the environmental constraints.

The resulting initial innovation outsourcing activity model is displayed as Fig. 5.15 below.

5.3.2.3 Structuring activities

The cluster of activities relating to the transformation process are assembled. The innovation outsourcing activity comprises two overlapping activities of selection and implementation which forms three sections of activity: selection only, overlapping selection and implementation, and implementation only.

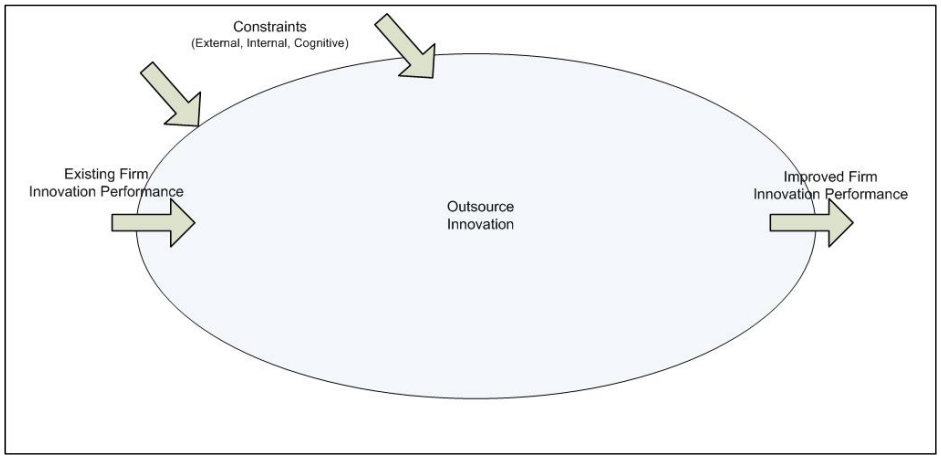


Figure 5.15: Stage 1 - Innovation outsourcing activity model development

The selection only section comprises the activities of determining 'what innovation should be outsourced' and identifying 'why innovation should be outsourced'. The overlapping selection and implementation section comprises the activity 'what innovation is to be outsourced'. The implementation only section comprises the activity 'how outsourced innovation is managed' day-to-day.

Arrows are added to show the dependency of the activities and the direction of the process. Two arrows are added between the selection and implementation activities. The first arrow leads from the selection only section to the selection and implementation section. The second arrow leads from the selection and implementation section to the implementation only section.

A bi-directional arrow is added between the 'what innovation should be outsourced' and 'why innovation should be outsourced' entities to display the dynamic nature of determining the innovation activity that should be outsourced. A firm may start with identifying why innovation should be outsourced and then determine the innovation activity that fits the criteria. Alternatively, firms may identify the innovation activity that has the potential to be outsourced and in conjunction identify the rationale for doing so.

The resulting stage in the development of the activity model is displayed in Fig. 5.16.

The cluster of activities relating to the 'what innovation is to be outsourced'

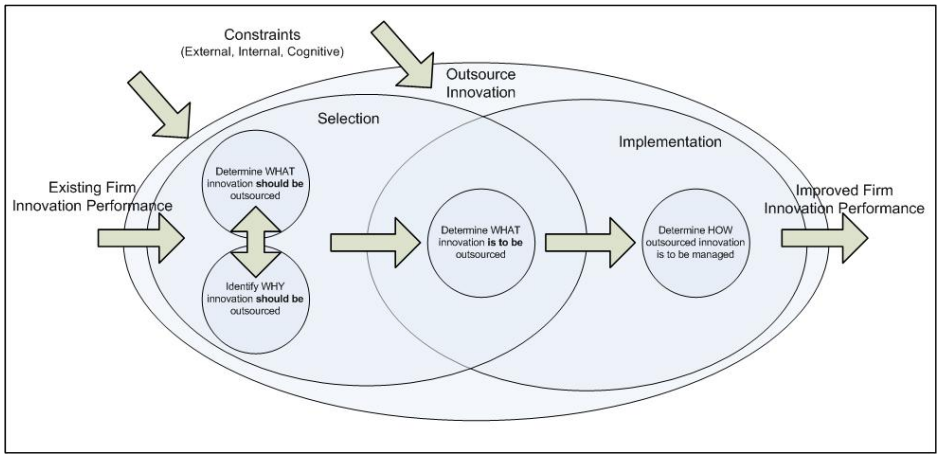


Figure 5.16: Stage 2 - Innovation outsourcing activity model development

are assembled. The cluster comprises three activities: identifying 'where innovation should be outsourced', identifying 'to who innovation should be outsourced', and identifying 'how innovation should be outsourced'.

Three bi-directional arrows are added, one between each of the three activities, to display the dynamic and inter-dependent nature of the activities in identifying what innovation can, *in reality*, be outsourced. For example, a firm can identify where and to whom it should outsource innovation, and then commit the necessary resources to implement the firm structures and routines to support its decision. Alternatively, a firm can identify the resources it has available to commit to organisational change to support innovation outsourcing and then determine where and to whom it should outsource to fulfil its innovation priorities and objectives.

Organisational change for innovation outsourcing is a continual process of fulfilment and improvement whilst there exist innovation activity that can potentially be outsourced. An arrow is added leading from the activity 'what innovation is to be outsourced' to itself displaying this continual process of organisational change for innovation outsourcing.

The resulting stage in the development of the activity model is displayed in Fig. 5.17.

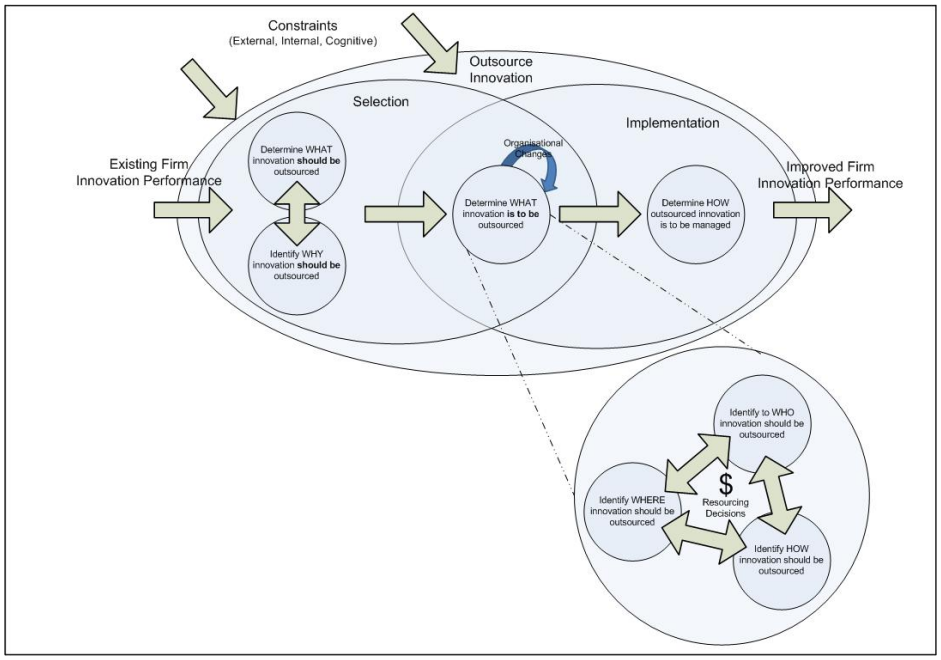


Figure 5.17: Stage 3 - Innovation outsourcing activity model development

5.3.2.4 Monitoring and control activities

The final stage in the development of the innovation outsourcing process overview model is to add monitoring and control activities.

Activities are identified for: establishing the criteria for the efficacy, efficiency and effectiveness of the innovation outsourcing transformation process; monitoring the activities of the innovation outsourcing process against these criteria, and; taking appropriate control action to ensure that that the objectives of the transformation process are achieved.

Criteria for efficacy relates to whether the innovation outsourcing transformation process is working to produce an improvement in innovation performance. Efficacy is dependent on identifying existing internal innovation activity that is appropriate for outsourcing and ensuring that appropriate structures and routines are in place to support its outsourcing. Criteria for efficiency relates to identifying whether the transformation is being achieved with the minimum use of resources. Efficiency of the transformation process is a judgement by senior

management in the firm that the investment decisions for outsourcing innovation are worthwhile. Criteria for effectiveness relates to whether the transformation is helping to achieve some longer term aim of the firm. Effectiveness of the transformation process is determined by improved firm innovation performance, using key performance indicators, which can be directly attributed to the outsourcing of innovation

Arrows are added to the three monitoring and control activities to show the direction of the process and the dependency of the entities. The final innovation outsourcing process overview activity model is displayed in Fig. 5.18.

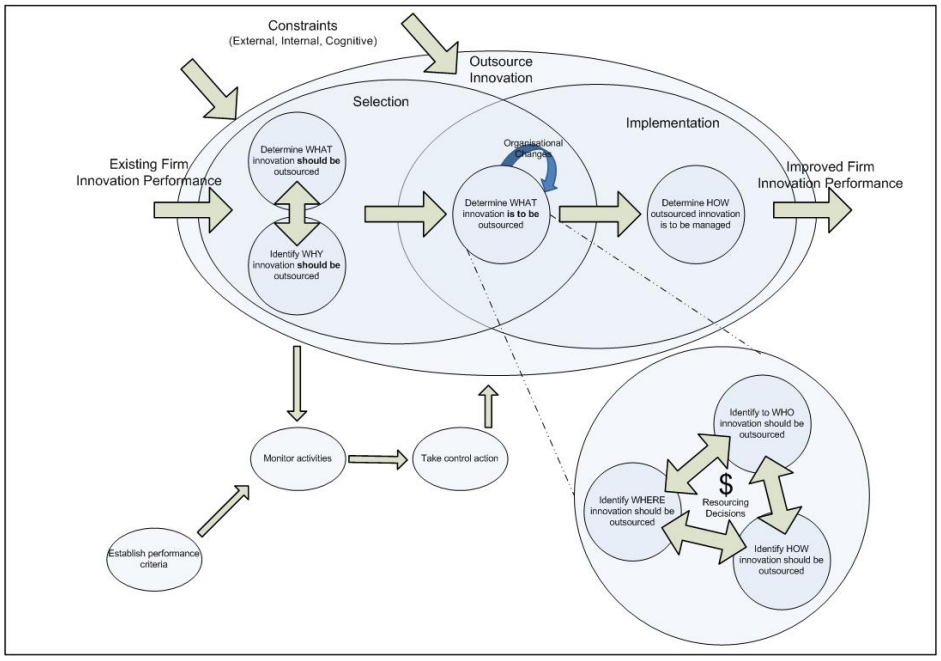


Figure 5.18: Final innovation outsourcing process overview activity model

5.3.2.5 Checking model against guidelines

Checking the final model against SSM guidelines is necessary to ensure that the development process has yielded a 'defensible' model.

The final model is checked to ensure that each and every phrase in the root definition leads to something in the model and that each and every activity in

the model can be linked back to an element of the root definition or CATWOE. A check is also made to ensure that the final model comprises only the minimum but necessary activities. The final model comprises six key activities which fulfils the 7 ± 2 guideline for the number of activities.

Each activity is checked for its dependency on another. Any activity with an arrow leaving it, but none entering should be one that can be done immediately because it does not have any dependency. An example of this is the two activities, determining 'what innovation should be outsourced' and identifying 'why innovation should be outsourced'. The transformation process can start with either of these activities independently of any other activity.

5.3.3 Rich picture model development - SSM(c)

The environmental constraints and each of the six key activities identified as part of the final process modelled are further developed with constituent elements and activities identified from the framework developed previously from the extant literature.

5.3.3.1 What innovation should be outsourced

Three key activities are identified for determining what innovation should be outsourced:

1. Analyse the firm's innovation ecosystem to identify innovation activity that can potentially be outsourced whilst retaining innovation activity associated with the firm's core competencies.

2. Analyse firm strategic factors to identify the position along the innovation continuum, (i.e. from raw ideas to market-ready products) at which innovation should be outsourced.

3. Analyse the scale and extent of all innovation that is potentially outsourced to mitigate the risk of over-outsourcing.

The two activities, identifying the position along the innovation continuum at which innovation should be outsourced and identifying the scale and extent of all

innovation that is potentially outsourced is dependent on the first activity which analyses the firm's innovation ecosystem. Arrows are used to show dependency and the direction of activity.

5.3.3.2 Why innovation should be outsourced

Determining why innovation should be outsourced involves a single activity, analysing the rationale for outsourcing and classifying it as either minimising innovation costs or maximising innovation profits.

5.3.3.3 Where innovation should be outsourced

There are four activities associated with where innovation should be outsourced:

1. Review location choices using a broad framework of criteria, e.g., government policy, strength of legal regime, and access to innovation talent.
2. Review the total costs and benefits of potential onshore/offshore location choices
3. Develop an offshoring strategy as a capability for managing innovation activities offshore.
4. Develop a capability for managing innovation activities onshore.

The development of appropriate strategies for managing innovation either onshore, offshore or both is dependent on the outcome of the review of the relative costs and benefits of potential location choices.

5.3.3.4 to Who innovation should be outsourced

Four activities are associated with to who innovation should be outsourced:

1. Identify mode of outsourcing by reviewing the strategic needs of the firm, i.e., scope, impact and customisation.
2. Identify a list of potential providers.

3. Select innovation outsourcing providers based on a comprehensive framework of qualitative and quantitative criteria.

4. Define the length of relationship

Potential innovation outsourcing providers are matched to the mode of outsourcing. The length of relationship is determined with consideration of both the mode of outsourcing and the provider selected to whom innovation is to be outsourced,

5.3.3.5 How innovation should be outsourced

The activities associated with how innovation should be outsourced are:

1. Increase modularity of product/service architecture and the associated knowledge and firm architecture whilst retaining alignment.

2. Identify and develop formal governance and control routines to mitigate the strategic risks associated with the leakage of intellectual property.

3. Identify and develop informal governance and control routines to mitigate the strategic risks associated with the leakage of intellectual property.

4. Use a framework to balance the use of formal and informal governance and control routines appropriate to the innovation outsourced.

5. Develop an organisational culture which supports outsourcing innovation and improves absorptive capacity.

Balancing the use of formal and informal governance and control routines is dependent on their identification and development.

5.3.3.6 How outsourced innovation is managed

The activities associated with how innovation is managed day-to-day are:

1. Managing innovation outsourcing through projects across the firm's physical and knowledge boundaries.

2. Developing a capability for managing innovation outsourcing through projects.

3. Developing an integration capability to develop new knowledge.

5.3.3.7 Environmental constraints

Environmental factors set the context for innovation outsourcing. One or more of these factors may act as stimuli for considering the outsourcing of innovation.

external factors: These comprise: increasing globalisation; new economic paradigm; increasing uncertainty; increasing race for talent; increasing external connections, and; strengthening legal regimes.

internal factors: These comprise: small firm size; low research intensity; declining productivity; value learning, and; financial factors.

cognitive factors: These comprise concepts relating to: openness; outsourcing as a make/buy decision; external R&D as a complement/supplement; resourcing; commitment, and adaptability.

5.4 Summary

This chapter has inductively developed a preliminary model for outsourcing innovation, comprising a set of propositions relating process and capabilities to performance. It serves as a starting point for validating and improving theory associated with outsourcing innovation.

Rich pictures have been developed of the preliminary model which are to be used as part of an organised process of enquiry and learning.

Chapter 6

Survey Design & Administration

This chapter addresses research objective 2(c), to 'design and administer a survey to gather appropriate data with which to test the preliminary model'. It develops a semi-structured interview survey protocol which is executed to elicit primary research data. The data gathered is used within the next chapter to deductively test and refine the preliminary generic holistic innovation outsourcing model previously synthesised. An overview of this chapter is displayed in Fig. 6.1.

6.1 Purpose of survey

The purpose of the survey is to gather primary data for deductively testing the preliminary generic holistic innovation outsourcing model that was inductively formulated in the previous chapter.

The preliminary model has been synthesised from a large and disparate literature data set. It is described as propositions which correlate the overall innovation outsourcing process and constituent capabilities to firm performance. The survey is used to gather relevant data to explore whether the correlations described by the propositions also exist in this different survey data set. If the correlations exist in the survey data set the propositions are confirmed under the observed circumstances. Where the correlations do not exist in the survey data set, there arises opportunity to improve the propositions. An explanation of the anomaly

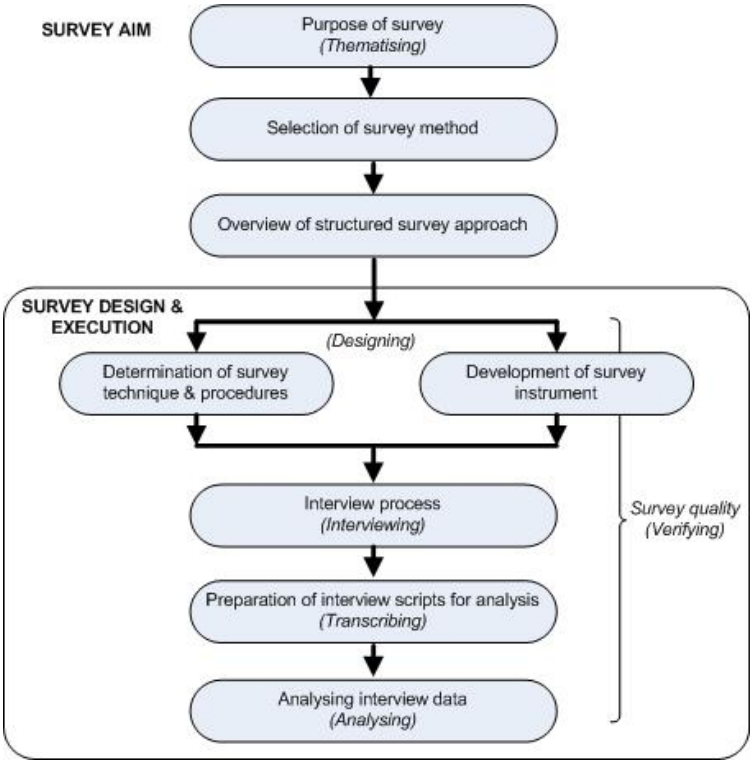


Figure 6.1: Overview of survey protocol development and execution

is sought by reviewing the steps which form the inductive stage of model building. The deductive testing and refinement of the model is addressed in the next chapter.

The survey data is used to explore propositions which relate to both the process and capabilities aspects of the model:

Process propositions: These are propositions h-p1 to h-p8 which were formulated and detailed in the previous chapter. The correlations described by the propositions relate firm performance to: value; undertaking an ordered set of activities; determining what innovation should be outsourced and why it should be outsourced; the alignment of deployment capability to the innovation activity being outsourced; the day-to-day management of outsourced innovation; investment decisions to align innovation outsourcing capabilities to the innovation activity

being outsourced; undertaking a portfolio approach, and; the development of dynamic capabilities.

Capabilities propositions: These are propositions h-c1 to h-c13c which were formulated and detailed in the previous chapter. The correlations described by the propositions relate firm performance to capabilities for: differentiating core capabilities; determining the development stage at which innovation is outsourced; determining the rationale for outsourcing; determining the level of proximities; determining the mode of outsourcing; developing a pool of potential providers; provider selection; determining the lifespan of an outsourcing relationship; determining the level and alignment of modularities; developing flexible firm structures; the use and balance of formal and informal governance & control; developing and nurturing innovation subcultures; managing through projects; managing knowledge, and; managing learning.

6.2 Survey selection

The selection of a survey research design is justified prior to consideration of the various survey research methods to fulfil the aims of this stage of the research study. A semi-structured interview survey method is chosen to gather and analyse data to test and refine the preliminary innovation outsourcing model.

Research design: A survey design is selected because it is commonly used with a deductive approach (Saunders et al., 2009). Surveys aim to provide a general picture across a 'population' and, consequently, are an appropriate research design for generating data with which to test the preliminary generic holistic model. The use of a case study design, whilst enabling a real-world perspective, is deemed inappropriate because it does not aim to cover a population and extract common factors.

Survey methods: These include the use of questionnaires, observation, and interviews. Questionnaires offer the advantage of enabling large amounts of data to

be collected efficiently from a large population and analysed quantitatively. Observation methods involve the systematic observation, recording, analysing and interpretation of behaviour. The data collected can be either qualitative using participant observation or quantitative using structured observation. The use of observation methods is most appropriate where data concerning behaviour is to be collected and analysed. Whilst behavioural data may contribute context to the holistic model, it is not the primary objective of this stage of the research study to understand the behaviour behind the relationship between innovation outsourcing capabilities and firm performance. Consequently, observation methods are deemed inappropriate.

Interviews offer a flexible method for collecting various data including factual information, circumstances, experiences, preferences, opinions, and reasoning. Interview methods enable the collection of richer and higher quality data than questionnaires, especially where the phenomena is complex. Interviews enable ambiguities to be explained, misunderstandings of questions to be corrected, and answers to be probed and clarified (Drever, 2003). Interviews also offer the advantage that they enable data to be continuously collected and analysed during the deductive/inductive cycling process.

6.3 Overview of survey

The development of a survey concerns making appropriate decisions for the collection and analysis of data. The decisions are required to be appropriate for the objective of testing and refining the preliminary generic holistic model for outsourcing innovation. In addition, due consideration is also required for the credibility, transferability, dependability, and confirmability of the study.

6.3.1 A systematic approach

It is generally held that the better the preparation for a survey, the higher the quality of the knowledge produced. In keeping with this opinion and to aid the credibility of this study a seven stage approach is adapted from a framework proposed by (Kvale and Brinkmann, 2009):

1. Thematising - This concerns formulating the purpose of the interview inquiry. Clarification of what the interview is to achieve and why is undertaken before commencing any interviews.

2. Designing - The design of the interview inquiry is planned taking in to consideration all the stages of the inquiry prior to conducting interviews.

3. Interviewing - Interviews are conducted based on an interview protocol. A reflective approach to the knowledge acquired is adopted. Attention is paid to the interpersonal situation during the interview.

4. Transcribing - Preparation of the interview material for analysis.

5. Analysing - Determining the modes of analysis appropriate to the interview material. These are dependent on the purpose of the interview and the nature of the interview material.

6. Verifying - Ascertaining the credibility, transferability, dependability, and confirmability of the interview findings.

7. Reporting - Effectively communicating the findings of the interview inquiry.

The 'Designing' stage is adapted to include the development of an interview survey instrument. The survey instrument is used to address the issue of how to present the complexities of innovation outsourcing attributes within an interview setting. The term 'transcribing', used for the stage where interview material is prepared for analysis, is replaced with the term 'preparation'. Typically, the term 'transcribing' is defined within the context of transforming the sound recording of a verbal conversation in to a written textual account. The generic term 'preparation' better describes the process of preparing data for analysis where interviews are not audio recorded. The decision not to audio record interviews is discussed later on within this chapter.

How each of the above seven stages are addressed within this chapter and study is outlined below:

Purpose of survey: *Thematising* - The purpose of the data gathered from the survey is to test and refine the preliminary generic holistic innovation outsourcing model previously formulated. The model is described as propositions which correlate the overall innovation outsourcing process, (h-p1 to h-p8), and constituent capabilities, (h-c1 to h-c13c), to firm performance.

Overview of survey: *Verifying* - A structured seven stage approach, adapted from a framework proposed by (Kvale and Brinkmann, 2009), is used as the foundation for the survey. The structured approach aids the application of credibility and dependability checks throughout the inquiry. Interviewer dependability and credibility is also aided by the use of a rich picture interview protocol document.

Survey design: *Designing* - Semi-structured interviews are planned with experts who have extensive experience of outsourcing innovation across several disparate industries. Consideration is provided to the time period over which the interview inquiry is undertaken, the number of interviews and the selection of interviewees. A rich picture interview protocol document is developed using soft systems methodology to overcome issues associated with data fragmentation and interview standardisation. An interview pilot is conducted to ensure that the survey's aims can be fulfilled.

Interview process: *Interviewing* - An interview process is adopted which comprises four parts: a preamble, the main body, a debriefing and post-interview.

Data preparation: *Transcribing* - The data collected during interviews was in various formats, including: hand-written notes, comments, annotations & diagrams, digital photographs, and electronic e-mail documents. Preparation of the raw data involved converting it to a uniform format of electronic word-processed text using Microsoft Word. A uniform format enabled easier analysis by aiding comparison and pattern searching.

Analysing interview data: *Analysing* - The process, (h-p1 to h-p8), and capabilities, (h-c1 to h-c13c), propositions which comprise the preliminary generic holistic innovation outsourcing model are analysed. Techniques of pattern matching and explanation building are used for the analysis because they are particularly applicable to the deductive analysis of qualitative interview data (Yin, 2009).

Model testing & refinement (chapter 7): *Reporting* - The detailed outcomes of the deductive testing and refinement of the innovation outsourcing model are presented within chapter 7 of this thesis document. They are contextualised within the purpose and philosophy of this study.

6.4 Designing

This concerns identifying the procedures and techniques for conducting the overall interview inquiry.

6.4.1 Semi-structured interviews

A semi-structured interview technique is used for the deductive stage of this study as it is the most appropriate technique for addressing the exploratory and explanatory nature of the research question and objective. Semi-structured interviews are used to explore how well the model is aligned to real-world practices and processes for outsourcing innovation, whether they confirm or contradict the model, i.e., 'find out what is happening and seek new insights' (Robson, 2002). A semi-structured interview technique is also used so that the innovation outsourcing framework can be informed whilst allowing the capture of meanings that interviewees attach to issues and situations in context (Easterby-Smith et al., 2002). It enables the opportunity to probe answers where it is required of interviewees to explain or build on their responses (Saunders et al., 2009).

6.4.2 Time period

The period of time over which the interview inquiry is conducted was borne in mind when developing the overview of the design.

Nonlinear process: Whilst, the overview of the design is presented above as a linear sequence of stages, it is appreciated that, in practice, the interview inquiry may require earlier stages to be revisited to clarify, refine or extend understandings of particular innovation outsourcing themes. An interview inquiry is often characterised as a back and forth process (Kvale and Brinkmann, 2009). The reflective nature of the back and forth process also aids credibility of the study.

Getting wiser: The use of theory-building and interview inquiries involves a continuous process of learning throughout this study. In line with the partially exploratory nature of this study, it is possible that interviewees may provide new and unexpected insights which require previous inquiry stages to be revisited. It is expected that interviewing quality will continually improve as more is learnt about the complexities and nuances of innovation outsourcing.

Time and resources: Sufficient time and resources for undertaking the interview inquiry were allocated. A period of nine months was judged appropriate for completing the seven stages of the inquiry. A significant period of the time was allocated to thematising, design, gaining access to appropriate interviewees, and analysing. Only a short period of time was allocated to the interviewing of subjects.

Notebook: To aid the credibility, dependability, and confirmability of the study, a notebook was used specifically and only for the interview inquiry over the nine month period. In the notebook was noted: themes and how their understanding changed; interview notes, and; reflections on individual interviews.

6.4.3 Sampling

Sampling concerns the methods for how interviewees are selected and the number of interviews conducted. Whilst its use is emphasised in quantitative studies, its use is important in qualitative studies to aid credibility, transferability, dependability, and confirmability.

Number of interviews: The number of interviews required for a study is as many as are required to find out what is needed to know. Especially in qualitative studies, (in general, although it is dependent on the purpose of the study), it is incorrect to assume that the quality of a study is improved with the number of interviews. The limits of identifying the number of interviews required for this interview inquiry are defined by this study's aim and objectives, and the available time and resources.

The aim of this study is to develop a generic holistic approach by which firms can successfully outsource innovation. The lower limit of the number of interviews required is defined by the need to, firstly, address the generic nature of this study's aim and, secondly, to ensure coverage of the complete innovation outsourcing process. The upper limit is defined by the time and resources available and the law of diminishing returns. If the number of interviews is too large there may be insufficient time to undertake detailed penetrating analysis of the interviews. There is also a certain point beyond which conducting further interviews will yield less and less new knowledge (Kvale and Brinkmann, 2009).

Taking in to consideration the above, the eventual number of interviews conducted to fulfil the aims of this study and interview inquiry was eight. The final number of interviews to be conducted was not defined beforehand. An initial rough estimate of 10 ± 5 interviews was anticipated, however, suitable interviewees were continually identified and interviews continually conducted until, at least, the aims of the inquiry were fulfilled. The focus of sampling was directed primarily towards the selection of interviewees.

Selection of interviewees: The credibility and dependability of this study is influenced significantly by the 'quality' of subjects selected to be interviewed. Whilst it is important to ensure that the questions being asked in an interview

inquiry are appropriate to address the objectives of the study, it is, ultimately, the responses which give rise to new insights. Consequently, especial consideration was provided to the selection of subjects to be interviewed.

Innovation outsourcing is not a general everyday concept which is familiar to all, it requires specialist knowledge. The population of potential subjects is defined by all those who have a familiarity with the concept. It is not appropriate to the aims of this study to use a representative sample using probability sampling, i.e., random selection. An opportunistic, snowballing sampling method was used to select a non-probability sample, i.e., some subjects within the population are more likely to be selected than others.

The criteria for the sampling frame are defined to fulfil the aim of this study, (i.e., to develop a generic holistic approach by which firms can successfully outsource innovation), and to aid the credibility and dependability of the interview inquiry. Interview subjects were selected based on their prior understanding of innovation outsourcing, their depth of experience within the domain, and their breadth of experience in working with numerous companies in various industry sectors.

Initially, potential interview subjects that fulfilled the above criteria and were known to the researcher or who had been suggested by colleagues were contacted. These potential interview subjects were then asked to suggest other potential interviewees.

6.4.4 Interview protocol:

An interview protocol is used to address two main concerns which impact the credibility, transferability and dependability of data collected. The concerns are particularly pertinent due to the complex and cross-discipline nature of the innovation outsourcing phenomenon. Firstly, a criticism that is sometimes made of frameworks that are inductively derived is that the process of categorising and coding data tends to fragment the data. This raises the concern that this may lead to a lack of understanding amongst interview participants of the continuity, dynamic and temporal nature of the innovation outsourcing process. Secondly, the lack of standardisation within interviews raises concerns of possible interview

bias where other researchers may not elicit the same data (Easterby-Smith et al., 2008).

An interview protocol is used to promote uniformity of understanding amongst interviewees and address concerns of the credibility, transferability and dependability of data collected. A key constituent of the interview protocol is an interview research instrument, developed using soft systems methodology (Checkland, 2006), to reflect the inductively-derived framework as rich pictures. The interview research instrument is detailed in Appendix A. The use of soft systems methodology to develop rich pictures reflects the systems theory approach in developing the framework. The use of rich pictures enabled the complex nature of innovation outsourcing constructs and the dynamic nature of the innovation outsourcing process to be better communicated during interviews. The interview research instrument also enabled the ease of note taking, data categorisation and constant comparison.

6.4.5 Interview pilot

Despite all the design and preparation for an interview, it is only when an interview is conducted that it is possible to know whether it will work in practice. A pilot was employed to enable a trial run of the interview under realistic conditions and to induce confidence through the experience of conducting the interview. It was also undertaken to provide feedback on the interview protocol and to ensure, as far as possible, that it met its primary purpose of addressing the interview inquiry.

6.5 Development of interview survey instrument

Innovation outsourcing is an intrinsically complex multi-faceted real-world phenomenon. The challenge arises of how to elicit and capture as much detailed, rich and nuanced information that effectively addresses the purpose of the inquiry within the time constraints of an interview session. The use of an interview instrument, (e.g., schedule or guide), can aid the interview process by including main questions, prompts and probes. Typically, an interview schedule is used for

structured interviews and an interview guide for unstructured or less-structured interviews.

The semi-structured nature of this interview inquiry suggests the adoption of an interview guide. The adoption of the type of interview instrument for a semi-structured interview is guided by the purpose of the deductive stage of this study. Testing the *á* priori generic holistic model of innovation outsourcing entails identifying both correlations and anomalies between innovation outsourcing attributes and firm performance outcomes. The lesser structure of an interview guide may aid the identification of anomalies but risks not being able to confirm all correlations. In contrast, the greater structure of an interview schedule may confirm all correlations, but risks not being able to identify anomalies between innovation outsourcing attributes and firm performance outcomes.

The crucial characteristic of any interview instrument adopted is that it must enable how interview participants view innovation outsourcing to be gleaned and that there is flexibility in how the interview is conducted (Bryman and Bell, 2011). The adoption of an interview survey instrument using rich pictures to present the complexity of innovation outsourcing attributes addresses the disadvantages associated with using either an interview schedule or guide in semi-structured interviews.

The structured development of the rich pictures that form the main section of the interview survey document are detailed below.

Three key activities are identified for determining what innovation should be outsourced:

6.5.1 The survey document

The rich pictures are operationalised as a 30 page survey document, (Appendix A), to address the objectives of the research. The structure of the document is detailed below.

6.5.1.1 Document structure

The interview survey document is to be provided to participants ahead of the interview to strengthen the dependability of the study. Particular attention is

paid to both the structure and aesthetics of the document to reflect good interview practice and portray credibility. The language used is clear, comprehensible and relevant to interview participants. The constituent elements of the document are outlined below.

front cover: The front cover is designed to create a positive first impression. The strong use of colour and graphics is used to improve the aesthetic appeal and portray a 'professional' document. There are clear simple titles identifying the documents context, i.e., innovation outsourcing, and the document's purpose, i.e., a management capability survey instrument. Cranfield University logos are to be used to portray the credibility and integrity of the study.

contents page: The contents page provides at a glance an overview of the document. The document comprises three sections: introduction, business information, and the survey body.

introduction: This section clearly displays the purpose of the document as a survey instrument to help identify how firms outsource innovation. The definition of the term 'innovation outsourcing' is stated to ensure that it is interpreted in the same manner by all participants. The context of the study is provided by explaining its significance to the firm. A clear description is provided of how the document is to be used.

business information: This section is designed to collect contact information, such as the: participant's name, company name, industry sector, job title and description, address and telephone number and email address. This information is collected because it is useful for contextualising participant answers.

innovation outsourcing reference model: The survey body comprises nine subsections corresponding to rich pictures portraying elements of the *á* priori generic holistic model for outsourcing innovation: Innovation outsourcing process overview; Environmental constraints; What should be outsourced; Why it should

be outsourced; What is to be outsourced; Where it should be outsourced; to Who should it be outsourced; How it should be outsourced, and; How is it managed.

The order of subsections is structured to enable interview questions to flow reasonably well during the interview, however, the document is sufficiently flexible to allow a focus on any particular aspect. Each subsection commences with a brief description of the associated rich pictures and, typically, a simple question, e.g., what approach does your firm take when outsourcing innovation?

6.5.1.2 Interview document shredding

A colleague who was sympathetic to the research study was asked to 'shred' the document, i.e., review it for faults or improvement relating to appearance, layout, and content. They were provided with a colour printed, bound paper copy and asked to imagine and comment on how a potential interviewee would react. The critical feedback received is outlined below. The criticisms were met and the document altered where possible.

appearance: At first glance, a fairly professional-looking document. Good use of graphics and colour scheme. Good use of white space, doesn't look too cramped. Large clear text. The document has too many pages.

layout: The document is easy to follow with a logical order. Good use of headings. The figures don't have page numbers.

content: Clear simple descriptions preceding each picture. Use of rich pictures very helpful in understanding the context of the questions. Perhaps, some of the rich pictures are too detailed.

6.6 Interviewing

This section details how the interviews for this study were conducted.

6.6.1 Approaching potential interviewees

The first step when undertaking an interview after a potential participant has been identified is to establish personal contact. This was undertaken via e-mail. E-mails offer the advantage of putting in writing the details of the request which is then delivered instantaneously. The recipient is then able to consider the request in their own time and respond accordingly.

The e-mail stated: who I was and what my interest was in contacting them; why I was contacting the person in particular, what I was seeking from them, and; a guarantee of confidentiality and a promise of feedback. The e-mail also encouraged further questions and provided a telephone number.

A three page document summarising the background and objectives of the study was attached to the e-mail. The aim of the document was twofold. Firstly, to instil confidence in the potential interviewee by displaying that significant work had already been done in the study and that significant preparation had been done prior to contacting them. This displayed to the recipient of the e-mail that their time and input was valued. Secondly, provision of the summary document at an early stage ensured that potential interviewees understood the nature, degree of complexity and scope of the subject under consideration ahead of any interview. This also gave the potential participants time to consider how their firm operated so that detailed and nuanced answers could be provided, thus strengthening the credibility and dependability of the study.

If a response to the e-mail was received displaying a positive interest, regular contact was maintained with the potential interviewee to identify a scheduled time and place for the interview. Any questions regarding the study or the interview were encouraged and appropriate answers provided. If a copy of the interview document was explicitly requested, it was provided for the same reasons that the summary document was provided, i.e., to strengthen the credibility and dependability of the study. It was not provided with the original e-mail to prevent overloading the recipient with a lot of information all at once.

If a negative response was received, the original recipient was thanked for their time. When a negative response was received because the recipient did not feel that they were suitably qualified to answer questions , others were recommended

within their organisation that were better suited to the study. This displayed that the summary document attached to the original e-mail was effective in both instilling confidence in the study and communicating its needs.

If a response was not forthcoming after a two week period a reminder e-mail was sent. If a response was not forthcoming after the reminder, it was assumed that the potential interviewee was either unable or unwilling to participate and no further contact was made. Rich and detailed information elicited from an interview setting is dependent on a willing and able participant.

6.6.2 Interview preparation

Prior preparation and planning is essential for obtaining the most from an interview. In particular, consideration was given to demonstrating credibility to obtain the confidence of interviewees so that they are more willing to share information.

Display of knowledge: It is self-evident that it is a requirement for a well-conducted interview to be knowledgeable about the research domain. It is also necessary to be knowledgeable about the organisational context in which the interview is to take place. Prior to the interview, the organisation to which the interviewee was researched online, in particular, their research and innovation strategy. Knowledge relating to the organisation was shared with the interviewee to gain credibility and the confidence of the interviewee.

Location: Where an interview is conducted can influence the data that is collected. The offer of travelling to the interviewee's place of work was always made for three reasons. Firstly, as a matter of courtesy and recognition that the participant is giving up their time to assist with the study. Secondly, the interviewee is likely to feel more comfortable in their own environment and, therefore, be more willing to share information. It also makes it easier for them to have at hand any information that they may wish to share. Finally, conducting the interview at the participants place of work contextualises interview responses to the environment in which innovation outsourcing decisions are made. Interviews were, typically, held in a quiet meeting room at the interviewee's place of work.

Presentation: An interviewer's appearance and demeanour can affect an interviewee's perception of their credibility and, consequently, interview responses. To ensure that the interviewer's credibility wasn't adversely affected, in keeping with the environment in which the interviews were typically conducted, the interviewer was well-groomed and in formal business attire. A professional but friendly demeanour was adopted.

Logistics: Arriving for the interview in good time further demonstrates credibility to the interviewee. Apart from being courteous, it portrays a professional attitude and displays to the interviewer that you understand that their time is valuable. Material for recording notes, i.e., a bound notebook and pen was taken to the interview as well as printed and bound paper copies of the interview document, previously supplied as electronic copies via e-mail to the interviewee.

Recording interviews: After consultation with both the colleague who undertook the 'shredding' exercise and the pilot interviewee, a decision was made not to audio record the interviews. The feedback was that the recording of an interview was unnecessary because the interview document provided sufficient context for recording the content of responses. It was not the aim of the interview inquiry to analyse meaning or language. It was also advised that responses may be less candid if the interview was being recorded and that the recording equipment and its operation may be a distraction.

A judgement was made that the advantage of interviewee candidness and spontaneity, especially within the context of innovation outsourcing where decisions relating to innovation selection and development where organisational politics may be an issue, was of greater benefit to the study than that offered by audio recording.

6.6.3 The interview process

Each interview comprised four parts: a preamble, the main body, a debriefing, and post-interview.

6.6.3.1 Preamble

The first few minutes of an interview are decisive. It is important to create an immediate connection with the interviewee. This was achieved by being at ease and clear about what was needed to know, listening carefully, being attentive, and displaying an interest.

The interviewee was provided with paper copies of two documents: the three page document summarising the background and objectives of the study that was attached to the original e-mail when requesting a meeting, and; a colour printed and bound copy of the full interview document. The researcher also had paper copies of the two documents. The documents were briefly explained.

The interview was introduced with a preamble which briefly described the purpose of the interview and clarified the term 'innovation outsourcing'. The interviewee was informed that written notes would be made during the course of the interview and that these would be recorded directly on to the interview document. The interviewee was asked whether they had a business card to save time completing the 'business information' section of the interview document. Often, a business card was provided after the interview. The interviewee was always asked to provide a brief description of their current role and background.

The participant was asked if there were any questions before the interview started.

6.6.3.2 Interview body

Typically, an interview commenced with asking the interviewee to review figure 1a within the interview document, followed by the question 'what approach does your firm take when outsourcing innovation'? Further questions were dependent on individual responses and the direction of the interview in relation to the overall innovation outsourcing process.

Interview notes were recorded by both the researcher and interviewee. Notes were taken in various and often several ways during a single interview session. Typically, notes were recorded by the researcher on either the main interview document or a notebook dedicated to recording interview responses. Interview responses recorded in the notebook were always linked to a page number of the

main interview document, and a rich picture where appropriate. Notes relating to responses were always recorded in full sight of the interviewee, enabling continuous checks to be made, to ensure that only what was meant by the interviewee was being recorded. Sometimes, an interviewee would make comments and annotations on their copy of the summary document. Where, this was the case, the summary document or a copy was retained by the interviewer. Sometimes, an interviewee would make annotations on the researcher's copy of the main interview document. Rarely, an interviewee made annotations on their copy of the main interview document. Where this was the case a copy of the annotated pages was made after the interview and the interview document returned to the interviewee. On several occasions, diagrams relating to the overall process model were drawn on a whiteboard by the interviewee. These were recorded within the researcher's notebook after the interview and where possible a photograph of the diagram was taken using a digital camera.

This approach taken to record interviews, using a continuous reflective approach to ensure that what was recorded was what was meant strengthens the credibility and dependability of the study. Care was taken to maintain distance within the interview by understanding the responses and not evaluating them.

6.6.3.3 Debriefing

The interview was concluded with the statement 'I have no further questions', and asking the interviewee whether they had anything further to add. If not, they were asked if there was anything else that they wanted to ask. Finally, the interviewee was thanked for their time. Depending on the enthusiasm displayed by the interviewee, they were also asked if it was agreeable to contact them should any clarification be needed to their responses.

6.6.3.4 Post-interview

After the interview notes were made about the context of the interview, especially concerning how the interview went. This included comments regarding whether the interviewee was cooperative, helpful, talkative. Comments were also made

concerning the working environment where the interview took place, whether it was dynamic, busy or subdued.

An e-mail thanking the interviewee for their assistance and time was always made as soon as possible after the interview but always within two days. Interview data was prepared for analysis as soon as possible after the interview whilst it was still 'fresh in the mind' of the interviewer. Where possible, this was always done prior to the next interview.

If any points requiring clarification arose during preparation of interview data, and depending on the enthusiasm and cooperation displayed by the interviewee, an e-mail was sent to the interviewee requesting explanation. This was often done within the same e-mail thanking the interviewee.

6.6.4 Pilot Interview

Despite all the preparation for an interview it is not until it is conducted that one knows how well it will work in practice. Piloting is a trial run under realistic conditions. It enables feedback from the interviewee of their interpretation and reaction to both the interview document and questioning.

The pilot interview was conducted with a participant from the sampling frame for the interviews. The interviewee was a professional knowledge manager with over 20 years experience of outsourcing relationships with several small and large organisations in various industries including engineering, technology and pharmaceutical. They had prior understanding of innovation outsourcing, a depth of experience within the domain, and a breadth of experience in working with numerous companies in various industry sectors. Beyond these criteria, the participant was selected due to their availability during the period that the pilot was scheduled. It was understood that the participant could not participate any further with the study beyond the pilot. Whilst this reduced the number of interviewees for the remaining interviews, it was deemed advantageous for strengthening the credibility and dependability of the study.

The interview was conducted as the interview process described above. If there was a difficult point, a note was made but the interview wasn't stopped to

discuss it. After the interview, general reactions and specific issues concerning the interview were invited.

6.6.5 Interviews

Interviews were conducted with eight senior executives and professionals with a combined total of over 150 years experience in innovation outsourcing. Due to the nature of the domain, almost all were educated to doctorate-level and many had additional management qualifications. Their experience related to numerous organisations in several industry sectors. The firms ranged in size, from small to medium enterprises (SMEs) with a turnover of less than £20m to global conglomerates with £multi-billion turnovers.

The interviews were conducted, where possible, at the interviewee's place of work according to the interview process described above. Interviews ranged in duration from between 20 minutes to 2 hours, with the majority of interviews lasting approximately one hour. The areas of the model covered and the pace with which they were covered during interviews varied according to the interests and experiences of individual interviewees. For example, some interviewees considered the model from an overall process perspective, whilst others focused on the details of particular aspects of the model.

A brief profile of each of the interviewees and the duration of each interview is provided below.

Interviewee ref. 01-hrkt-aero: Head of research and knowledge transfer with over 23 years experience of innovation outsourcing primarily within the aerospace and defence industry sectors. Duration of intervew: one hour.

Interviewee ref. 02-pd-fmcg: Programme director with over 10 years experience of innovation outsourcing within the luxury goods and fmcg industry sectors. Duration of intervew: one hour.

Interviewee ref. 03-d-metl: Director with over 20 years experience of outsourcing innovation in the global metals industry. Duration of intervew: twenty minutes.

Interviewee ref. 04-md-manu: Managing director with over 20 years experience of global innovation outsourcing in the manufacturing sector. Duration of intervew: one hour and ten minutes.

Interviewee ref. 05-src-manu: Senior research consultant with over 25 years experience in the manufacturing sector. Previously held board level and director level positions and has extensive innovation outsourcing experience. Duration of intervew: one hour and fifteen minutes .

Interviewee ref. 06-sopc-vari: Senior organisational performance improvement consultant with over 30 years experience in several varied sectors including the automotive, aerospace and steel industries. Duration of intervew: one hour and thirty minutes.

Interviewee ref. 07-peng-tech: Project engineer with over 15 years experience in managing collaborative technology research programmes in several varied sectors including the automotive, aerospace and defence industries. Duration of intervew: two hours.

Interviewee ref. 08-cons-tech: Consultant with less than 5 years experience of working on collaborative technology research programmes within the automotive industry sector. Duration of intervew: one hour.

6.7 Preparation

The qualitative data collected during interviews was in various formats. These included hand-written notes, comments, annotations and diagrams on various documents: the three page document summarising the background and objectives of the study; the 30 page rich picture survey instrument; the researcher's interview notebook. Qualitative data was also captured as digital photographs and as electronic e-mail documents.

Preparation involves the conversion of qualitative data collected during interviews in to a uniform format of electronic word-processed text using Microsoft

Word. A uniform format enables easier analysis by aiding comparison and pattern searching.

Each interview is saved as separate word-processed file. The filename used maintains confidentiality and preserves anonymity whilst being easily recognisable by the researcher (Saunders et al., 2009). The format of the filename used is: two character interview number, hyphen, four character job role, hyphen, four character ,main industry sector. For example, '01-hrkt-aero' relates to interview one conducted with the head of research & knowledge transfer concerning innovation outsourcing in the aerospace industry sector.

To maintain context, the data is converted in strict order of the interview conversation. Whilst the rich picture interview survey document is structured to enable interview questions to flow logically through the process, the interview was flexible to allow focus on any aspect the interviewee wished. Each note or comment is linked to a page number and rich picture diagram within the rich picture interview survey document.

The data collected for each interview session was also evaluated for the coverage of propositions. To fulfil the generic and holistic aims of the study complete coverage of the propositions are required with at least two different industry sectors. Interviews were continued using snowball sampling at least until sufficient data was collected to fulfil the aims of this stage of the study.

6.8 Analysing

Subsequent to preparation, interview data is analysed to explore whether the correlations between innovation outsourcing attributes and firm performance outcomes identified in the inductive stage also exist here.

6.8.1 Analytical procedures

Qualitative data is diverse in nature, consequently, there are no standard procedures for analysis (Saunders et al., 2009). Subject matter knowledge often carries more weight than the application of specific analytical techniques (Kvale and Brinkmann, 2009).

A common mode of analysis for interview data is bricolage which refers to putting something together using whatever tools are at hand (Kvale and Brinkmann, 2009). Typically, the researcher reviews the interview material, highlighting interesting parts, and uses metaphors, connections, and structures to capture meaning.

A similar approach to generate meaning is the use of ad hoc techniques proposed by (Miles and Huberman, 1994). These techniques include, for example: identifying themes; seeing plausibility; clustering; metaphors; counting; contrasts/comparisons; partitioning variables; subsuming particulars under the general; factoring; noting relations between variables; finding intervening variables; building a logical chain of evidence, and; making conceptual/theoretical coherence.

Two techniques that are particularly applicable to the deductive analysis of qualitative interview data are pattern matching and explanation building (Yin, 2009). The use of these techniques is dependent on devising theoretical propositions prior to collecting data. Consequently, they are aligned with and sit comfortably with the theory building approach proposed by (Christensen, 2006) and used within this study.

6.8.1.1 Pattern matching

Pattern matching involves testing the adequacy of the *á* priori innovation outsourcing model developed in the preceding inductive theory-building stage. This is undertaken by checking whether the interview data matches the previously formulated propositions that make up the model. Where the interview data matches a proposition it is confirmed and an explanation has been found where any threats to the credibility of conclusions can be discounted (Saunders et al., 2009). There are two variations to pattern matching described by (Yin, 2009).

- Dependent variables - This is where the likely outcome arises from another independent variable. If the predicted outcome is found in the interview data, then the theoretical explanation is appropriate to the findings. If a different outcome to the one predicted is found in the interview data an alternative explanation needs to be found.

- Independent variables - This is where a number of alternative explanations are formulated, using variables independent of each other, to explain an outcome. Only one of the explanations may be valid. Where one explanation with the predicted outcome is found in the interview data, then this is regarded as the explanation. Consequently, the other explanations are discarded.

6.8.1.2 Explanation building

Explanation building is an iterative pattern matching technique which builds an explanation while collecting and analysing data. At first glance, it appears to be similar to a grounded theory (Glaser and Strauss, 1967) approach. Explanation building deductively tests theoretical propositions to build explanations whilst grounded theory inductively develops propositions to explore theory. The technique comprises six stages:

- Development of a theoretically based proposition.
- Collection of data and comparison with the proposition.
- Amendment of proposition in the light of comparison with data.
- Further data collection which is compared to the revised proposition.
- Amendment of revised proposition in light of findings from latest iteration.
- Iterations are continued until a satisfactory explanation is reached.

To fulfil the exploratory, descriptive and explanatory aim and objectives of this study, a combination of pattern matching and explanation building techniques are used to analyse the interview data collected.

6.9 Summary

This chapter has adopted a step-wise and structured approach to developing and executing a survey inquiry to gather primary data. The data is used in the next chapter to deductively test and refine the preliminary generic holistic innovation outsourcing model previously synthesised.

Chapter 7

Model Validation, Refinement & Discussion

This chapter addresses research objective 2(d), to 'analyse the results of the survey to deductively validate & refine the model'. An overview of the chapter is displayed in Fig. 7.1.

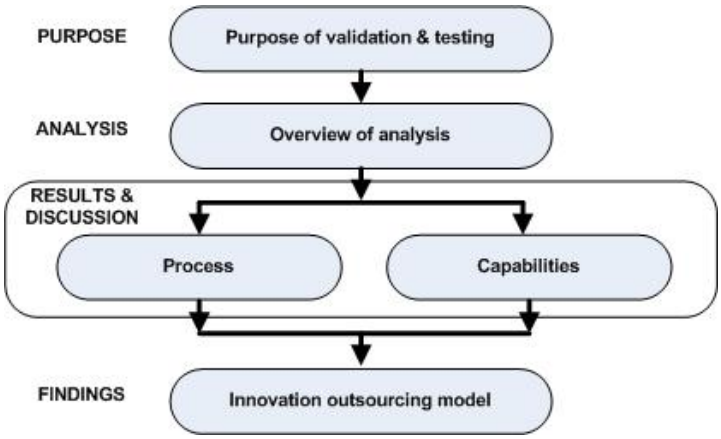


Figure 7.1: Overview of development of innovation outsourcing model

The outcomes of a process of analysis are presented as findings to describe how firms can successfully outsource innovation, fulfilling the aim of this study.

7.1 Purpose of validation & testing

The purpose of validating and refining the model for innovation outsourcing is to identify and continually improve how firms can successfully outsource innovation. It represents the final stage of a two stage process for building descriptive theory relating to the phenomenon of innovation outsourcing. This is illustrated in Fig. 7.2.

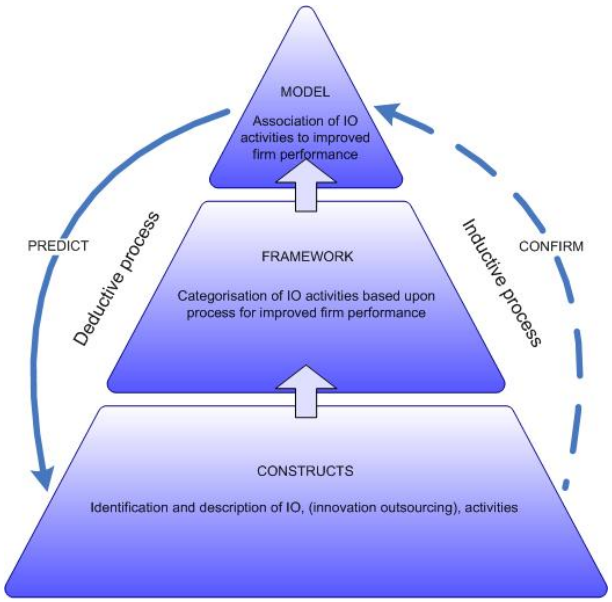


Figure 7.2: Deductive testing & refinement of innovation outsourcing model

The innovation outsourcing process and capabilities propositions that comprise the generic holistic innovation outsourcing model are tested by identifying whether the correlations that they describe also exist in the interview survey data set.

If the correlations exist in the survey data set the propositions are confirmed under the observed circumstances. Where the correlations do not exist in the survey data set, an explanation is sought by reviewing the steps which form the inductive stage of model building. The propositions are refined to reflect

the explanation and tested again. The model is continuously developed through successive cycles of explanation and testing.

7.2 Overview of data analysis

Semi-structured interviews were conducted with eight senior executives and professionals, utilising an interview protocol. The qualitative data collected were prepared for analysis by conversion to a uniform format.

The prepared interview data is used to test the preliminary holistic innovation outsourcing model. This is undertaken by exploring whether the data confirms or contrasts with the correlations between innovation outsourcing attributes and firm performance outcomes, (i.e., process and capability propositions, p-p1 to p-p8 and p-c1 to p-c13c), which constitute the preliminary holistic innovation outsourcing model.

The interview data is compared with the propositions through a process of pattern-matching and explanation building to validate propositions and explain anomalies. A validated overall innovation outsourcing model addresses this study's research aim of developing a generic holistic approach by which firms can successfully outsource innovation

7.3 Presentation of results

Communicating the outcomes of studies is not a matter of simply re-presenting what was done and found. Such studies tend to be both boring and tedious to read (Kvale and Brinkmann, 2009). Well communicated outcomes are the result of detail that is contextualised within the frame of the purpose and philosophy of the study.

The purpose of this study is to facilitate organisational capability for managing the outsourcing of innovation by addressing the primary research question, 'how can firms successfully outsource innovation'? This is achieved by developing, testing and refining a capabilities process model which forms a generic holistic approach by which firms can successfully outsource innovation.

In doing so, a critical realist philosophical stance is adopted in keeping with the real-world nature of innovation outsourcing as a management discipline. It is within this context that comparison of the outcomes of interviews with the propositions previously developed in the inductive stage of descriptive theory-building is undertaken. The knowledge arising from the comparison is justified discursively in conversation.

The process aspects of the overall innovation outsourcing model are considered prior to the individual capabilities that make up the model.

7.3.1 Performance (p-p1)

Performance realisation through the creation of value is ultimately the rationale for outsourcing innovation. Its management is incorporated in proposition **p-p1** which proposes that 'performance through innovation outsourcing is managed by ensuring the total utility of benefits outweigh the costs of achieving the delivered benefits'. This requires innovation managers and decision-makers to ascertain and track both the utility of benefits and the costs involved in outsourcing innovation.

There is little or no evidence to identify that managers explicitly ascertain or track the benefits and/or costs involved in outsourcing innovation, *'Perhaps, only one of the eight companies would seek to monitor performance to identify whether innovation outsourcing was successful' [06-sopc-vari].* This is true for both large and small firms. It was acknowledged, however, that ascertaining and tracking innovation outsourcing performance is non-trivial, *'measuring outsourcing value is difficult' [01-hrkt-aero].*

expected performance: Whilst firms do not explicitly measure innovation outsourcing performance, interview data does identify a focus on performance expectations, *'... have set high level targets. The targets are associated with reducing costs and increasing profits' [07-peng-tech].*

A possible explanation for a focus on expectations rather than actual outcomes of innovation outsourcing performance is the lack of a holistic understanding of innovation outsourcing.

Innovation outsourcing processes may still be immature, fluid, and insufficiently embedded within firms, *'There exist formal procedures for outsourcing, but they are not necessarily followed; procedures are short-circuited' [01-hrkt-aero]*. In such circumstances, managers often revert to traditional innovation management finance procedures, *'Finance is managed close to the product' [01-hrkt-aero]*, where the specific costs associated with outsourcing innovation may be neglected, making outsourcing value difficult to ascertain.

The short-circuiting of innovation outsourcing procedures also suggests that senior management misunderstand the level of resources, and consequently the costs, associated with outsourcing innovation, *'Managers are asked to do too much, not enough resources' [01-hrkt-aero]*.

7.3.2 Overall process stepwise walkthrough

A reflective step-by-step walkthrough of the overall innovation outsourcing model, illustrated as Fig. 7.3, was initiated by an interviewee, *'I can understand it better, if I see it big on a wall' [02-pd-fmcg]*. The meeting was conducted in the main meeting room of the premises where a large whiteboard was available.

process verification & validation: The interviewee reviewed the structure of the process model by considering how innovation outsourcing is undertaken in practice and relating real-world activities to each of the individual sub-tasks and their connection to related sub-tasks.

The walkthrough was led by the interviewee who sought to both confirm the model where there was agreement and challenge it where inconsistencies were observed. Care was taken by the researcher to maintain distance throughout the walkthrough. The researcher did not prompt the interviewee and only commented when clarification was sought by the interviewee. Consideration by the interviewee of the following aspects of the preliminary process model were observed.

7.3.2.1 Process overview

Reviewing the top-level process view, (i.e., input, output, transformation, and constraints), it was observed by the interviewee, that whilst it was assumed that

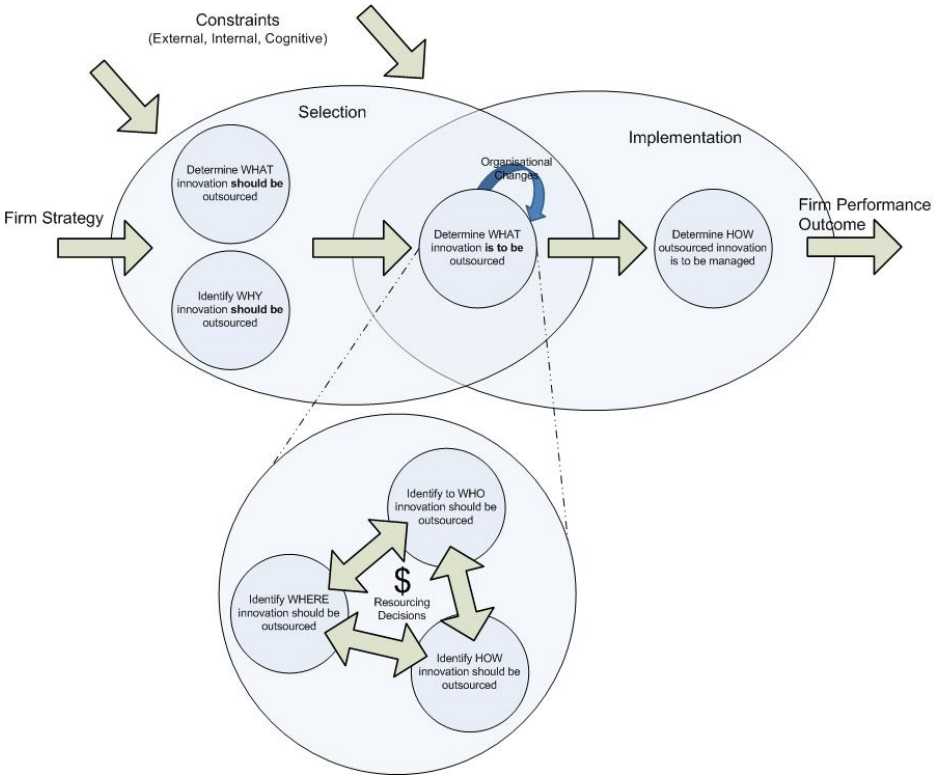


Figure 7.3: Preliminary innovation outsourcing process

the model was 'read' from left to right, there didn't exist an explicit starting point to direct the reader. It was suggested that a starting point be made explicit.

strategy as input: The interviewee concurred with the need to align outsourced innovation to organisational strategy. Consequently, firm strategy is recognised as an input to the innovation outsourcing process. It was suggested by the interviewee that the input arrow labelled 'Firm strategy' be re-labelled to just *'strategy' [02-pd-fmcg]* to avoid misinterpretation of its meaning as *'fixed and unchangeable strategy' [02-pd-fmcg]*, rather than its intended meaning of the strategy of an organisation, company or business.

performance as output: The interviewee also concurred that whilst organisations outsource innovation for various reasons, (including access to specific skills

and the realisation of lower development costs), ultimately, the rationale was to improve firm performance. The ultimate outcome of innovation outsourcing was recognised as improved firm performance. It was suggested that the output arrow, 'firm performance outcome' be re-labelled to *'performance outcome' [02-pd-fmcg]* for the same reason as above.

constraints: The interviewee acknowledged that innovation outsourcing was subject to various constraints which can be inside or outside the organisation, and within the mindset of managers.

7.3.2.2 A three-stage process (p-p2)

Proposition **p-p2**, i.e., 'performance through innovation outsourcing is dependent on undertaking an ordered set of activities relating to: the determination of innovation activity to be outsourced; the deployment of innovation to be outsourced, and; the management of outsourced innovation', is confirmed.

The walkthrough of the preliminary innovation outsourcing model by the interviewee identified innovation outsourcing as a strategic activity comprising two inter-related tasks, *'Action process 1' [02-pd-fmcg]*, i.e., 'selection' and *'Action process 2' [02-pd-fmcg]*, i.e., 'implementation' whose overlap forms an intermediate task, *'Externals' [02-pd-fmcg]*, i.e., 'deployment' which includes the identification, assessment and mitigation of the risks associated with outsourcing innovation. This is illustrated in Fig. 7.4.

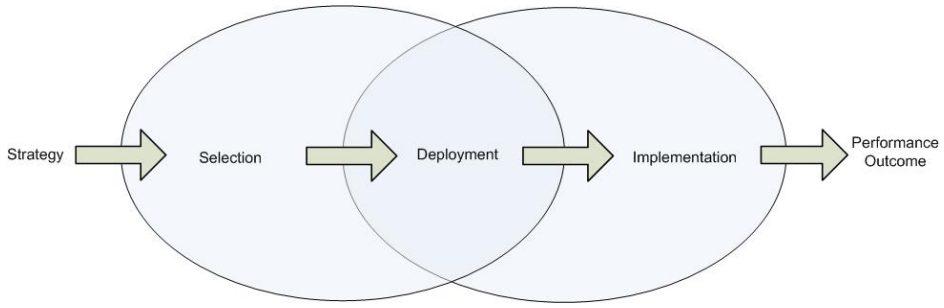


Figure 7.4: The three stages of the innovation outsourcing process

bottom-up approach: The review procedure undertaken by the interviewee reveals that managers consider innovation outsourcing as individual inter-related activities, which are subsequently grouped as higher-level tasks.

The walkthrough of the preliminary innovation outsourcing model mirrored the bottom-up development of the template and preliminary innovation outsourcing process model, where sub-tasks and their connections were identified and then grouped as overlapping top-level 'selection' and 'implementation' tasks. This confers a notable degree of credibility, transferability, dependability, and confirmability to both the final preliminary process model and the method with which it was developed.

7.3.2.3 Selection (p-p3)

Proposition **p-p3**, i.e., 'performance is dependent on a firm's capability for determining what innovation should be outsourced and why it should be outsourced', is confirmed.

Reviewing the preliminary innovation outsourcing model on a whiteboard, the interviewee identified the two sub-tasks, 'what innovation should be outsourced' and 'why innovation should be outsourced'. These sub-tasks were subsequently grouped by the interviewee as constituent elements of the 'selection' task, thus supporting proposition p-p3.

initiating selection: During the walkthrough, the interviewee gave consideration to which of the 'what' and 'why' sub-tasks were undertaken initially; whether it was to identify, firstly, what innovation activity should be outsourced, or whether it is why an innovation activity should be outsourced.

Within the rich picture model, the 'what' and 'why' sub-tasks are intentionally positioned in alignment with each other and an output arrow arising from a combined consideration of the two sub-tasks. This is to signify that the innovation outsourcing process can be initiated with either of the 'what' or 'why' sub-tasks, but the decision for one task is required to be aligned to the other. For example, an organisation may first identify what innovation activity it undertakes and then determine whether there exists a rationale for its outsourcing. Alternatively, an organisation may first determine why it wishes to outsource innovation, (e.g., to

reduce the cost of its innovation activity), and then identify whether there exists any innovation activity which fulfils that rationale. This issue is discussed further in section 7.3.4.1 Initiating selection - 'what' or 'why' sub-task? of this chapter.

7.3.2.4 Deployment (p-p4)

Proposition **p-p4**, i.e., 'performance is dependent on the alignment of deployment capability, (i.e., the determination of where, to whom, and how innovation is outsourced), to the innovation activity being outsourced', is confirmed.

The interviewee identified during the walkthrough, sub-tasks concerning the determination of the location, supplier and manner in which innovation is outsourced, i.e., 'where', 'who' and 'how' were identified by the interviewee, *'who to - contractor, how to - implement, where - location' [02-pd-fmcg]*, as requirements prior to outsourcing innovation activity. Only when there is positive *'confirmation, agreement' [02-pd-fmcg]* on the outcomes of these sub-tasks should outsourced innovation activity be implemented.

infrastructure stability: The need for *'infrastructure stability' [02-pd-fmcg]* prior to implementation of outsourced innovation was identified by the interviewee as necessary for realising improved performance. Infrastructure stability concerns determining both the capability and capacity of existing structures and procedures to support the total innovation activity outsourced. Any infrastructure changes are required to be undertaken prior to outsourcing, and executed in a phased and controlled manner to maintain stability.

external process engagement: It was also observed by the interviewee that an advantage of the intermediate stage between 'selection' and 'implementation' was that external involvement in the innovation outsourcing process could be limited until internal decisions had been made, *'this is good. I like that. It's good that you can limit external involvement to a particular area' [02-pd-fmcg].*

7.3.2.5 Implementation (p-p5)

Proposition **p-p5**, i.e., 'performance is dependent on a firm's capability for the day-to-day management of outsourced innovation', is confirmed.

Concurring with the preliminary innovation outsourcing model the walkthrough identified the aim of the 'how' sub-task to be *'how to manage and support' [02-pd-fmcg]* outsourced innovation. The sub-task's primary purpose was observed to be the management of *'external' [02-pd-fmcg]* boundaries, without which innovation outsourcing performance would be compromised.

7.3.3 Capabilities investment & development (p-p6)

Proposition **p-p6**, i.e., 'performance is dependent on appropriate investment decisions to align innovation outsourcing capabilities to the innovation activity being outsourced', is confirmed.

The proposition is tested by identifying whether managers assess existing capability prior to outsourcing innovation, and whether investment decisions relating to innovation outsourcing capability are aligned to the innovation activity being outsourced.

Interview survey data identifies instances where existing capability was assessed, identified as insufficient, and enhanced through appropriate investments prior to outsourcing the innovation activity, *'There was a deliberate act to change culture. Interventions were undertaken to change culture. A culture change model was used. Culture was measured both before and after implementation of the model.' [04-md-manu].*

There also exist instances within interview survey data where existing capability was assessed, identified as insufficient, and the innovation activity was not outsourced because the additional investment was deemed inappropriate. It was commented by an interviewee that there were a lot of projects that he would like to do, but couldn't find supplier's or partners who were able to undertake the projects, *'can't find the people' [03-d-metl].* The suggestion that consideration be given to developing a capability to build a pool of potential innovation outsourcing partners/suppliers was met with an exclamation of incredulity, *'What! You want me to have people sitting [around] and looking for people' [03-d-metl].* A

judgement had clearly been made by the interviewee that the potential benefits of pursuing the innovation projects through outsourcing did not outweigh the additional investment for developing a pool of potential innovation outsourcing partners/suppliers.

Other instances are identified during interviews where existing capability was not assessed prior to outsourcing, *'No prior checks were done on capability for managing location. This put us on the back foot. This gave the German supplier a commercially strong negotiating position.' [04-md-manu].*

investment decisions: Outsourcing innovation requires specific capabilities which differ to those for internal R&D. Consequently, prior to outsourcing it is necessary to assess whether there exists sufficient capability and capacity for outsourcing any additional innovation activity. If there is insufficient capability, a further decision is required to identify whether it is worth making the investment to sufficiently enhance capability to outsource the additional innovation activity. This is achieved by comparing the potential benefits of outsourcing with the additional investment required. Where the potential benefits outweigh the additional costs involved, the investment is expected to be made to enhance capability and outsourced the additional innovation activity. Where the additional investment outweighs the potential benefits it is appropriate that the innovation activity to be outsourced is reviewed.

Insufficient capability exposes the firm to the various risks (Piachaud, 2002) associated with outsourcing innovation and, ultimately, poor firm performance. Over-investment and a surfeit of capability results in poor firm performance through the waste of scarce resources.

Making appropriate investment decisions which align innovation outsourcing capabilities to the innovation activity being outsourced is only possible, however, if managers possess a holistic understanding of the capabilities that constitute innovation outsourcing.

7.3.4 Portfolio approach (p-p7)

The adoption of a portfolio approach to outsourcing innovation concerns consideration of a firm's total innovation activity which is segmented according to whether it is best undertaken within or outside the firm. This enables a firm's list of potential innovation outsourcing projects to be evaluated and prioritised prior to the allocation of resources. Doing so, provides the following advantages (Cooper et al., 2001) over the discrete consideration of individual projects:

- Strategic alignment - ensuring innovation outsourcing efforts match the needs of the firm's overall strategy.
- Maximising value - ensuring the highest returns relative to investment.
- Balance - managing risk versus reward based on particular characteristics, (e.g., type of innovation - incremental/radical).

This is asserted as proposition **p-p7**, i.e., 'a portfolio approach to outsourcing innovation is positively associated with performance'. Whilst proposition p-p7 is confirmed, it is also identified that a transactional approach to outsourcing innovation can be positively associated with firm performance.

7.3.4.1 Initiating selection - 'what' or 'why' sub-task?

The adoption of a portfolio management approach has implications for the selection task of the preliminary innovation model. The stepwise walkthrough of the overall innovation outsourcing model highlighted a decision confronting managers during the 'selection' task, whether to identify, firstly, what innovation activity should be outsourced or why an innovation activity should be outsourced?

It is asserted through proposition **p-p7** that performance is achieved through the adoption of a portfolio management approach which requires, firstly, the determination of what innovation activity should be outsourced.

Initiating innovation outsourcing with the sub-task, 'what should we outsource' obliges a firm to review the scope of its innovation activity, define its innovation boundary, and allocate resources accordingly.

Determining the scope of a firm's innovation activity involves identifying all the innovation activity that a firm undertakes within the firm as well as outside it. Consideration of the activity as a whole enables segmentation of the innovation activity according to how significant it is to the firm against its capability relative to other organisations. In general, where the firm is more capable than other organisations the innovation activity is undertaken within the firm and where it is less capable it can potentially be outsourced. Consequently, a firm is able to determine its innovation boundary by identifying what innovation activity it should undertake within the firm and what should be outsourced. Consideration of a firm's innovation activity as a whole also enables it to identify the resources that are currently used by the firm and available to it. Resources can then be allocated appropriately according to whether the innovation activity is undertaken within the firm or outsourced.

7.3.4.2 'What' sub-task

Interview evidence displays instances where firms firstly identify what innovation activity should be outsourced and adopt a portfolio management approach, supporting proposition **p-p7**, *'there is a technology strategy from which we get a technology routemap that includes the technology requirements and where we see the technology coming from' [01-hrkt-aero]*; *'... differentiates between on-car innovation and off-car innovation' [07-peng-tech]*, and; *'... seeking to implement an integrated product lifecycle management programme with waves of implementation' [07-peng-tech].*

Typically, organisations that adopt a portfolio approach are large global organisations that have strong innovation outsourcing and integration capabilities due to significant investment.

7.3.4.3 'Why' sub-task

There also exists much interview evidence which identifies that several firms adopt a transactional approach to outsourcing innovation and initiate the selection task with identifying why innovation should be outsourced, *'... adopted a discrete ad hoc approach to outsourcing innovation', [06-sopc-vari].* This is counter to

the portfolio approach, and the advantages it offers, i.e., strategic alignment, maximisation of value, and the balance of risk & reward.

This may be due to firms either being unaware of the capabilities necessary for outsourcing innovation or choosing to allocate scarce resources on differing priorities, *'companies adopted a discrete ad hoc approach to outsourcing innovation. None took a portfolio approach to reviewing their innovation outsourcing needs. The companies adopted a gut feel approach to outsourcing innovation. Many of the companies had a thought process for outsourcing innovation led, primarily, by a single person within the company.' [06-sopc-vari].* Typically, firms adopting a discrete transactional approach to innovation outsourcing are SMEs, (small to medium-sized enterprises), who do no possess the same level of resources as larger global organisations that, typically, adopt a portfolio approach.

The adoption of a transactional approach may also be due to a firm's external environment. Operating in a dynamic and competitive market, it may be necessary to continually respond to an immediate need, *'the reason was lead time to market' [04-md-manu]*, and *'the decision to outsource was based on whether there was sufficient internal capacity' [04-md-manu].* In a particular example, the firm operated in an industry where its products were highly regulated by legislation. If they had sought to develop the product internally, the legislation would have moved on and the product would have been obsolete by the time it came to market. Typically, such decisions are taken at the project level rather than a strategic level.

combining tce and rbv: The above interview evidence contradicts traditional theory of transactional cost economics, (tce) (Williamson, 1985) (Williamson, 1975). Under such circumstances, (i.e., high asset specificity, high uncertainty and high infrequency), tce asserts that hierarchical governance should be employed, i.e., the firm should either develop the capability internally or acquire an organisation with the capability. An explanation is offered by (Barney, 1999) who introduces the notion of capabilities to combine the rbv, (resource-based view), with tce theory. He asserts that when the cost of hierarchical governance to gain access to capabilities is high, a firm may nevertheless choose to use non-hierarchical governance, (i.e., outsourcing). This is because they simply view

opportunism as part of the cost of gaining access to the specific capabilities, *'If we could, we would have developed internally, but the legislation would have moved on by the time we got the product to market' [04-md-manu].*

7.3.5 Continual improvement (p-p8)

Proposition, **p-p8**, 'the continual identification, resourcing and development of capabilities aligned to the innovation activity being outsourced is positively associated with sustained performance' is supported.

Interview survey data displays that where a specific lack of capability is identified, action is taken to improve capability, *'There was a deliberate act to change culture. Interventions were undertaken to change culture.' [04-md-manu].* In addition, where there is an oversight of innovation outsourcing capability, firms are keen to ensure lessons are learnt, *'There were language and cultural issues with suppliers, especially with the US. The expectation was that this would not be an issue.' [04-md-manu].*

dynamic capabilities: These are at the core of the overall innovation outsourcing model. The achievement of a firm's strategic innovation outsourcing objectives can only be sustained if its capabilities are able to be updated and adapted to changing circumstances and needs. This notion of dynamic capabilities (Teece et al., 1997), i.e., 'the capacity of an organization to purposefully create, extend, or modify its resource base' (Helfat, 2007), is encompassed within each of the three stages, (i.e., selection, deployment and implementation), of the preliminary innovation outsourcing model. This is asserted as proposition p-p8 and summarised in Fig. 7.5,

learning-by-doing: The case for the innovation outsourcing process as a set of dynamic capabilities is supported by interview survey data displaying it to be a learning-by-doing process.

'We knew we needed to go outside the company to develop the innovations. We built relationships where we needed the capability and the capacity. There was

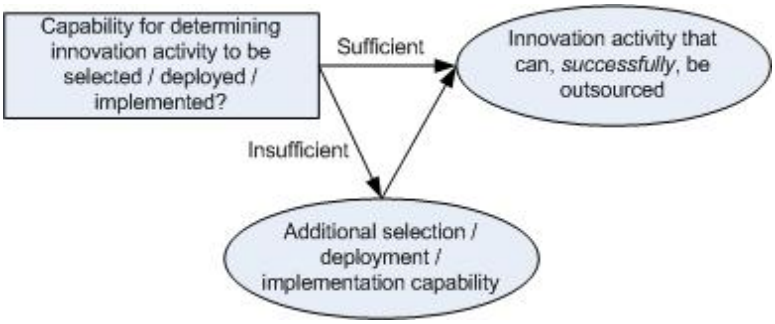


Figure 7.5: Assessment of sufficient innovation outsourcing capability

a degree of learning involved. We didn't realise some of the problems we would encounter. Not every relationship worked. This was due to both the product and how we managed the relationship. Outsourcing innovation was built on relationships with key suppliers in key areas and building an innovation ethos' [04-md-manu].

7.3.6 Capabilities

Individual capabilities which constitute the three stages of innovation outsourcing and their relationship to firm performance are explored below:

7.3.6.1 Differentiating core & non-core activity (p-c1)

Proposition, **p-c1**, i.e., 'performance is dependent on the effectiveness with which innovation activities associated with core capabilities are differentiated from those associated with non-core capabilities' is supported.

Interview survey data identifies that firms outsourcing innovation are highly aware of their core activity and highly protective of it, they *'protect their crown jewels' [01-hrkt-aero].* The routines used by firms to differentiate activity displays an understanding of the need to positively identify both core & non-core activity at a detailed level, *'The company tried to maintain core capability. Where the development was not core we used a supplier. We used sensor suppliers for our hardware. It was not a core capability. Our capability was in integration of hardware and software' [04-md-manu].*

7.3.6.2 Optimal stage of development (p-c2)

There was no interview survey data captured to either support or reject proposition **p-c2**, i.e., 'performance is dependent on the effective determination of the optimal stage along the innovation continuum at which a particular innovation is outsourced'.

7.3.6.3 Clarity of rationale (p-c3)

Proposition, **p-c3**, i.e., 'performance is dependent on a firm's ability to determine clear and unambiguous rationales for outsourcing specific innovation activity' is confirmed.

Interview survey data displays that firms have differing rationales for outsourcing innovation. Firms understand that they need to look outside the firm to acquire new knowledge and capabilities, *'companies seeking new ideas from outside the business' [06-sopc-vari]*, because *'knowledge is rapidly changing' [01-hrkt-aero]* and that they do not have endless resources to develop these within the firm's boundary. Due to management pressure, firms also seek to outsource innovation in order to *'minimise costs' [01-hrkt-aero]*.

Whilst firms have differing rationales for outsourcing innovation, they are very clear about their reasons for doing so. Firms do not conflate, potentially conflicting objectives, *'the reason was lead time to market, not cost' [04-md-manu]*.

7.3.6.4 Location choice (p-c4)

Proposition, **p-c4**, i.e., 'performance is dependent on a firm's ability to determine the level of various proximities, (i.e., spatial, organisational, cultural, and professional), associated with supplier/partner location' is confirmed.

global outlook: Encouraged and *'supported by government' [01-hrkt-aero]*, firms adopt a global outlook. Consequently, many firms also seek to outsource innovation abroad.

differentiating location and supplier choice: Interview evidence displays the importance of ascertaining capability for managing proximities. This is achieved only by differentiating the choice of location from that of supplier. Not doing so, by viewing location choice as a consequence of supplier choice, exposes the firm to issues concerning proximity, and consequently lower firm performance, *'The choice of location of where to outsource was capability driven, not geographic. We had a choice of (supplier/partner) companies which could be a choice of one to many which drove the location. There were innovation suppliers that were outside the UK. A particular supplier was from Germany. No prior checks were done on capability for managing location. This put us on the back foot. This gave the German supplier a commercially strong negotiating position' [04-md-manu].*

assessing differing proximity types: Interview evidence also identifies the need for careful consideration of each individual type, (i.e., spatial, organisational, cultural, and professional), of proximity, *'There were language and cultural issues with suppliers, especially with the US. The expectation was that this would not be an issue. What do they say, "two countries divided by a common language". There were issues with a device failing. The US supplier was putting the device through testing and saying that they were fine. Failure rate definitions meant different things to the US supplier. Our assumption was that they meant the same, but they meant other things. It got sorted out eventually' [04-md-manu].*

cautious approach: Due to the time and resources it takes to develop adequate capability for managing various proximities when outsourcing innovation, it is appropriate that firms adopt a cautious approach, *'Looked at offshoring to China. They think, what a headache if that went wrong, who the bloody hell's going to sort that out' [05-src-manu].*

7.3.6.5 Mode of outsourcing (p-c5)

Proposition, **p-c5**, i.e., 'performance is dependent on the ability to align the mode of outsourced innovation to a firm's strategic needs' is confirmed.

Mode of outsourcing refers to the type of relationship that a firm adopts with its partner or provider when outsourcing its innovation activity, e.g., acquisition, R&D contract and strategic alliance.

mode appropriate to needs: Innovation outsourcing performance is dependent on ensuring a mode of outsourcing appropriate to the firm's needs, *'The mode of outsourcing was a preferred supplier contract. It was a formal contract and was appropriate to our needs' [04-md-manu].*

mode inappropriate to needs: Selecting an inappropriate mode of innovation outsourcing results in either objectives not being realised and/or a waste of scarce resources, and consequently lower firm performance.

An initial knee-jerk reaction by a large car manufacturer to use acquisition as a mode of outsourcing to fulfil its technology needs were identified to be inappropriate. This was only realised after resources had been wasted, *'this was identified to be inappropriate due to conflicts between the available technology and business aims. There was a realisation of the need to undertake longer-term research. Business had a five year outlook and viewed matters from a strategic perspective. Solutions are sought from organisations with expertise in high-value manufacturing IT, e.g., automotive industries, aerospace industries and university departments. A collaboration mode was adopted with OEMs, SMEs, and universities.' [07-peng-tech].*

7.3.6.6 Pool of providers (p-c6)

Proposition, **p-c6**, i.e., 'performance is moderated by the ability to develop and maintain a large and diverse pool of potential innovation outsourcing partners/providers' is confirmed.

pool of providers: Firms proactively developing and maintaining a pool of potential providers are able to respond rapidly to new opportunities for which they need capabilities that aren't immediately available within the firm, *'Suppliers were identified from external inputs including technical conferences, customers and other suppliers' [04-md-manu].*

lack of provider pool: In contrast to above, firm's that do not invest in developing a pool of potential providers accumulate potential innovation projects that they are unable to fulfil, possibly resulting in lost opportunities. A particular manager bemoaned, *'Who can do the work? Can't find the people' [03-d-metl].* The suggestion that they may wish to explore the possibility of developing a pool of potential providers, was met with the response, *'What! You want me to have people sitting [around] and looking for people?' [03-d-metl].*

7.3.6.7 Determining provider (p-c7)

Proposition, **p-c7**, i.e., 'performance is moderated by the ability to develop and use a comprehensive multi-criteria decision-making framework for selecting the most suitable innovation outsourcing partner/provider' is confirmed.

broad & balanced criteria: Firms use a broad range of both formal and informal criteria for selecting appropriate partners/providers for outsourced innovation, *'supplier selection was both formal and informal. Formal selection criteria was based on customary criteria such as finance, IP, etc. Informal selection criteria was based on visits to the company and building a relationship.' [04-md-manu]*, *'They made an assessment based on various criteria. There were formal agreements. Initially, there was lots of talking' [05-src-manu].*

'trust' as criteria: Interview evidence displays the significance of 'trust' as a crucial element of informal partner/provider selection criteria, *'Links were created between the two companies at a technical, organisational, and managerial level' [04-md-manu]*, *'The providers and suppliers for outsourced innovation programmes are selected through personal contact and trust relationships' [07-peng-tech].*

7.3.6.8 Length of relationship (p-c8)

There was no interview evidence captured to either support or reject proposition, **p-c8**, i.e., 'performance is moderated by the ability to determine the optimal lifespan of an innovation outsourcing relationship'.

7.3.6.9 Degree & alignment of modularity (p-c9a to p-c9d)

Propositions **p-c9a, p-c9b, and p-c9c** propose that performance is moderated by the ability to determine the appropriate level of: product/service architecture modularity; knowledge architecture modularity, and; organisational design modularity, respectively.

Furthermore, proposition, **p-c9d**, proposes that performance is dependent on the ability to align each of the above modularities, (i.e., product/service, knowledge, and organisational), for the outsourced innovation activity.

Interview evidence supports propositions p-c9a, p-c9c, and p-c9d. No interview evidence was identified to either support or reject proposition p-c9b.

product/service modularity: Firms possess a good understanding of product/service modularity and its relationship to firm performance when outsourcing innovation. Modularity forms an integral aspect of the lifecycle design and development of products/services by firms, *'we needed to ensure lifecycle modularity' [05-src-manu].* Consequently, firms find little or no need for further modularisation when outsourcing particular aspects of their innovation. They seek only an 'appropriate' degree of product/service modularity, and not complete modularity, when outsourcing innovation, *'instruments were already modular. Some items were integrated, they could have been more modular. The instruments included both hardware and software' [04-md-manu].*

organisational design modularity & alignment: Interview evidence displays that firms actively review the organisational design necessary to support outsourced product/service innovation. Consideration is provided, at a strategic level, to the degree of integration, i.e., modularity, between various organisational departments to ensure alignment of objectives with outsourced innovation, *'the company originally had a silo mentality. Development needed to be made to talk to procurement, manufacturing, and service & support. This was done by getting strategic input at a high level from the outset. In the end, Sales and Procurement were very close to Development' [04-md-manu].*

7.3.6.10 Degree of flexibility (p-c10a to p-c10c)

Propositions **p-c10a, p-c10b, and p-c10c** propose that performance is dependent on the flexibility of: information technology structures; firm finance procedures, and; innovation employment intensity. Interview survey data provides some support for these propositions.

Interview evidence identifies that the efficiency and effectiveness of innovation outsourcing is aided by flexible firm structures and procedures relating to information technology, finance, and employment. It is also identified that differing degrees of flexibility are required depending on whether the nature of the outsourced innovation activity is complementary or substitutive.

complementary outsourced innovation: When complementing existing innovation activity with that sourced from outside their boundaries, interviewees did not identify a need to either review nor enhance the flexibility of existing structures and procedures. There was also no evidence captured during interviews to suggest that structures and procedures were inflexible. It is likely that firms already possess sufficiently flexible information technology, finance and employee infrastructure that they are able to cope with any incremental demands placed on them when outsourcing innovation: *'finance is managed close to the product' [01-hrkt-aero]*; *'no special finance procedures were used ' [04-md-manu]*; *'extra resource was brought in when necessary' [04-md-manu]*. Modern information technology systems are inherently flexible with sufficient capacity to manage incremental demand.

substitutive innovation outsourcing: In contrast to above, the substitution of a firm's innovation activity with that sourced from outside its boundaries, typically, involves significant change to its organisational design. The decision to transfer innovation activity from within a firm is accompanied by a broad review of the scale and function of firm infrastructure, including information technology, finance procedures and number of employees. The success of such decisions is dependent on the flexibility of these factors. Where sufficiently flexible routines do not exist, they are developed as the need arises. An example of a flexible finance procedure developed when outsourcing substitutive innovation activity

is, *'We were experts and they subcontracted the complete power system. We were a power supply design house. What deal did we put together? They paid for development, but if you can use it elsewhere we will pay you less. They had clauses that said we couldn't sell to competitors.' [05-src-manu].*

7.3.6.11 Governance & control (p-c11a to p-c11c)

Propositions **p-c11a, p-c11b, and p-c11c** propose that performance is dependent on the ability to develop and balance formal and informal governance & control when outsourcing innovation. These propositions are supported by evidence from interview survey data.

robust approach: Interviews identify that firms are acutely aware of the downsides of poor governance & control in innovation outsourcing relationships, *'this was driven by a competitor who didn't adequately protect their patents and lost IP. Competitors were able to copy the product with a minor amendment' [04-md-manu].* Consequently, they take a robust approach to governance & control when outsourcing innovation despite the cost, *'the company was always careful with its IP. Everything was covered by patents. IP protection was very high. It was very expensive to maintain patents.' [04-md-manu].*

formal routines: Formal governance & control forms the foundation of innovation outsourcing relationships, *'Governance & control is very formal' [01-hrkt-aero], 'There were formal agreements.' [05-src-manu].* The *'emphasis is on IP ownership' [01-hrkt-aero]*, to the extent that *'relationships are renegotiated if IP ownership isn't favourable' [01-hrkt-aero].* Firms delay outsourcing relationships rather than risk loss of IP. For incremental innovation activity that is outsourced, typically, *'the patents were already in place' [04-md-manu].* However, for non-incremental innovation activity that is outsourced, where existing IP protection didn't exist, *'we would delay until they were in place. This slowed us down from time to time' [04-md-manu].*

informal routines: Firms also display various informal routines and procedures for governance & control when outsourcing innovation. Informal governance routines are used in addition to formal routines when selecting potential innovation outsourcing partners/suppliers; *'they make an assessment based on various criteria including: quality, price, finance, experience' [04-md-manu]*; *'alternative suppliers were often assessed using informal methods; what did the plant look like? how they answered questions?' [04-md-manu].*

Informal control is used when there is asymmetry in the relationship between the outsourcing firm and partner/supplier, *'even if we could prove our parts worked, [and the problem was elsewhere], we got beaten up' [05-src-manu].*

Peripheral knowledge is also used as an informal control mechanism, *'Some engineers had sensor knowledge, but it wasn't core' [04-md-manu].*

balance of routines: Firms outsourcing innovation always use both formal and informal governance & control routines to protect IP and ensure that their objectives are achieved; *'There is a balance between the formal and informal procedures that are used to govern and control outsourced innovation programmes' [07-peng-tech].* Formal routines are used as the primary governance & control mechanism which are then supplemented with informal routines. Interview survey data did not identify any examples where either only formal or informal routines were used. The data also didn't display any examples where informal routines were used as the primary governance & control mechanism.

longer-term control: Whilst a robust and effective approach to governance & control cannot be underestimated, firms are also aware that, ultimately, *'it is crucial that the interface [between the two organisations] works' [05-src-manu].* Effective innovation outsourcing relationships are built on trust and mutual understanding, *'takes a long time to make partnerships; these are the best relationships' [05-src-manu].*

7.3.6.12 Organisational culture (p-c12)

Proposition, **p-c12**, i.e., 'performance through improved absorptive capacity is dependent on the development and nurturing of subcultures appropriate to the

innovation activity outsourced' is confirmed.

inappropriate culture: Firms, typically, possess an innovation culture that is aligned to developing innovation within the bounds of the firm. This culture may also comprise a variety of subcultures specific to the firm and its innovation activity; *'there is a spread of cultures' [01-hrkt-aero].* Innovation outsourcing, however, requires a different culture to that for internal development, and which also needs to be aligned to the firm's various subcultures. Inappropriate culture for innovation outsourcing results in poor firm performance because, *'integration of knowledge is a struggle, a lot of work doesn't get exploited' [01-hrkt-aero].*

appropriate culture: Interview evidence displays that firms understand the need for an appropriate culture for innovation outsourcing to succeed. *'There was a deliberate act to change culture. Interventions were undertaken to change culture. A culture change model was used. Culture was measured both before and after implementation of the model. This resulted in a flow of new products and market leadership with 40% market share. If we hadn't implemented the culture change, we would have been third out of three key suppliers in the industry' [04-md-manu].*

7.3.6.13 Day-to-day management (p-c13a to p-c13c)

Propositions **p-c13a, p-c13b, and p-c13c** propose that performance is:

- moderated by the ability to manage innovation outsourcing through projects.
- dependent on the ability to understand what constitutes knowledge and control its flow across boundaries.
- dependent on the ability to learn by combining new architectural and component knowledge with prior knowledge.

The above propositions are supported by evidence from interview survey data.

managing through projects: Ensuring that outsourced innovation objectives are achieved involves the day-to-day management of various factors, including: innovation activity, schedules, quality, decisions, attitudes, skills, stakeholders, teams, contracts, finance, communication, risk, etc. In order to handle the inherent complexity and uncertainty of outsourced innovation, firms have adopted a multi-tiered approach including project management.

'Day-to-day management was undertaken at multiple levels. At a project level via the development manager who was also responsible for the technical team. At a commercial level through [head of] purchasing and [at a strategic level] through the managing director. Each liaised directly with their counterparts in the supplier company' [04-md-manu].

managing knowledge: Communication with partners/suppliers is an inherent aspect of outsourced innovation; *'there is constant contact with consortium partners through networking and knowledge transfer networks. There are monthly meetings to communicate information and progress.' [07-peng-tech].* Interview survey data identifies that firms are especially careful of managing communication and the flow of knowledge across the firm's boundaries.

'They also shared information between each other. The sharing of information was done via a communications file. Everyone who had contact with the supplier completed a visit report or telephone report. There was a debriefing after any meeting with the supplier' [04-md-manu].

'Communication was always managed, especially where the technical team was concerned. We had one engineer, a physics graduate, who was technically brilliant, but didn't know when to keep quiet. They would ask a question and he would tell them everything. He was managed very carefully. Any communication was regarded as commercial intelligence' [04-md-manu].

Firms also view the knowledge management as a key aspect of learning, *'a lot of companies use knowledge management so that they know how to learn from their mistakes' [05-src-manu].*

managing learning: Firms appreciate that *'knowledge is rapidly changing' [01-hrkt-aero]*, and that the integration of knowledge produced through innovation outsourcing is essential for firm performance, *'there is a focus on the level of absorptive capacity necessary to integrate the outcomes of outsourced innovation.' [07-peng-tech].*

To aid learning and ensure that they are able to fully utilise the outcomes of outsourced innovation, firms seek to manage and disseminate any knowledge produced. *'The intention at the outset was to create a knowledge base. In the end we didn't because it was too complex. There was no formal system, but we ensured that tacit knowledge was spread around and not held centrally' [04-md-manu].*

Some firms, however, especially those adopting a portfolio approach find that *'integration of knowledge is a struggle, a lot of work doesn't get exploited' [01-hrkt-aero].*

7.4 Discussion of findings

Findings concerning the overall innovation outsourcing process and its associated capabilities, fulfilling this study's objective of identifying how firms can successfully outsource innovation, are illustrated as Fig. 7.6, and summarised below.

7.4.1 Process

Findings concerning the overall innovation outsourcing process are summarised and discussed below.

7.4.1.1 p1. performance

Support for the realisation of performance through the model's process was identified during the process walkthrough and interviews. Firms do not, however, have an explicit focus on measuring either the total utility of benefits nor the costs of achieving delivered benefits. They view the measurement of innovation outsourcing performance as difficult. This is possibly due to the lack of a holistic understanding of what innovation outsourcing entails and, consequently, which

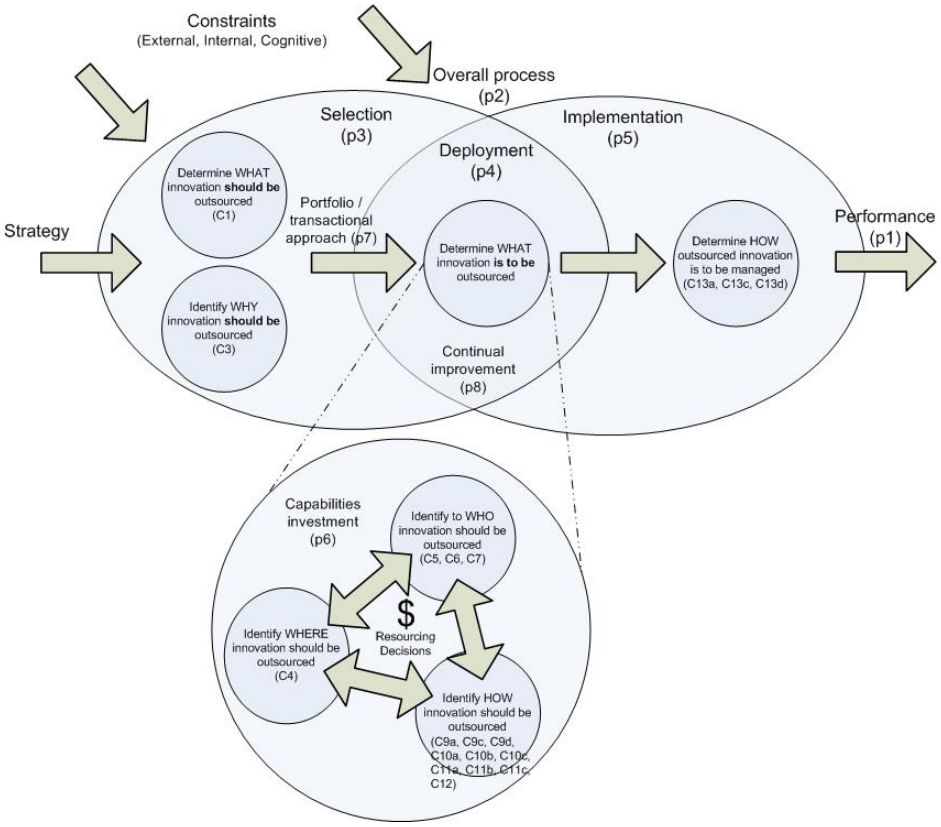


Figure 7.6: Overall innovation outsourcing process findings

costs and benefits should be measured. Firms *implicitly* associate value creation - and, consequently performance - with innovation outsourcing. Existing practice displays an expectation of performance but not a framework for its realisation.

In summary, proposition p1, (i.e., 'performance through innovation outsourcing is managed by ensuring the total utility of benefits outweigh the costs of achieving the delivered benefits'), is not confirmed by existing practice, but does find support amongst interviewees.

comparison with extant knowledge: Survey results support existing knowledge which identifies that firms focus on perceived expectations, rather than actual outcomes (Hsuan and Mahnke, 2011). It adds to existing knowledge by, firstly, proposing why firms have an insufficient focus on actual innovation out-

sourcing outcomes, and, secondly, by providing an outline framework, defined by a holistic model, for realising performance.

7.4.1.2 p2. overall process

Innovation outsourcing is a three stage process involving, the determination of innovation activity to be outsourced, (i.e., selection); the deployment of innovation to be outsourced, (i.e., deployment), and; the management of outsourced innovation, (i.e., implementation).

comparison with extant knowledge: Survey results contrast with existing knowledge which views the innovation outsourcing process simplistically as two discrete and independent steps of selection and implementation (Cui and Loch, 2011) (Murray et al., 2009). Existing views disregard the need for ascertaining and deploying appropriate firm structures and procedures for managing the specific risks associated with innovation outsourcing.

7.4.1.3 p3. selection

The selection of innovation to be outsourced involves determining what innovation should be outsourced and why it should be outsourced. Whilst selection can be initiated by determining either what innovation should be outsourced or why innovation should be outsourced, one must be aligned to the other.

comparison with extant knowledge: Survey results add to existing knowledge by identifying that the selection of innovation activity can be initiated with the determination of either the innovation activity to be outsourced or the rationale for outsourcing, but that they must be aligned.

This contrasts with the extant literature which conflates decisions relating to the selection of innovation activity with the selection of supplier/partner (Cui and Loch, 2011).

7.4.1.4 p4. deployment

The deployment of outsourced innovation involves the alignment of a firm's innovation outsourcing capability, (i.e., the determination of where, to whom, and how innovation is outsourced), with the innovation activity to be outsourced.

comparison with extant knowledge: Survey results contrast with existing knowledge (Cui and Loch, 2011) (Murray et al., 2009) by identifying an intermediate stage, (i.e., deployment), between the selection and implementation of outsourced innovation to ensure sufficient organisational capability and capacity for outsourcing. An intermediate deployment stage aids the efficiency & effectiveness of the innovation outsourcing process by supporting infrastructure stability and limiting unnecessary external process engagement.

The extant literature disregards the need for an effective organisational infrastructure in order to mitigate the risks associated with innovation outsourcing.

7.4.1.5 p5. implementation

The implementation of outsourced innovation involves the day-to-day management of outsourced innovation.

comparison with extant knowledge: Survey results support existing knowledge which displays the need for effective management of outsourced innovation (Cui and Loch, 2011).

7.4.1.6 p6. capabilities investment

Appropriate investment decisions to align innovation outsourcing capabilities to the innovation activity being outsourced is positively associated with innovation outsourcing performance.

comparison with extant knowledge: Survey results add to existing knowledge by displaying the need to consider and, if appropriate, invest in innovation outsourcing capabilities to aid performance. It identifies that sufficient consideration and investment in innovation outsourcing capabilities aids performance.

Survey results add to existing knowledge by displaying that insufficient consideration and investment in innovation outsourcing capabilities moderates performance due to lost opportunity. It can also be inferred that over-investment in innovation outsourcing capabilities is negatively associated with performance.

Survey results supports existing knowledge by displaying that insufficient consideration and investment in innovation outsourcing capabilities moderate performance due to increased risk (Piachaud, 2002).

7.4.1.7 p7. portfolio/transactional approach

A portfolio or transactional approach may be adopted for outsourcing innovation.

comparison with extant knowledge: Survey results add to existing knowledge by displaying that either a portfolio or transactional approach can be adopted for outsourcing innovation.

The adoption of a portfolio approach is consistent with initiating selection by determining what innovation activity is to be outsourced. The adoption of a transactional approach is consistent with initiating selection by determining why innovation activity should be outsourced.

The extant literature does not refer to a specific approach.

7.4.1.8 p8. continual improvement

The continual identification, resourcing and development of capabilities aligned to the innovation activity being outsourced are positively associated with sustained performance.

comparison with extant knowledge: Survey results add to existing knowledge by displaying that innovation outsourcing involves undertaking deliberate interventions to existing organisational routines and procedures. Interventions are undertaken to ensure capabilities are appropriate and sufficient for the innovation activity being outsourced.

This purposeful creation, extension and modification of a firm's innovation outsourcing resource base supports existing knowledge relating to the notion of

dynamic capabilities (Teece et al., 1997) (Zollo and Winter, 2002). It also provides support to the definition of innovation outsourcing as a strategic initiative which has the potential to provide competitive advantage.

7.4.2 Capabilities

Findings concerning the capabilities associated with the innovation outsourcing process are summarised and discussed below.

7.4.2.1 c1. differentiating core & non-core activity

Expected performance through innovation outsourcing is dependent on the effectiveness with which innovation activities associated with core capabilities are differentiated from those associated with non-core capabilities.

comparison with extant knowledge: Survey results support existing knowledge which identifies that firms have a clear focus on their core innovation activity which they differentiate from their non-core activity (Festel et al., 2011) (Sen and MacPherson, 2009).

7.4.2.2 c3. clarity of rationale

Expected performance through innovation outsourcing is dependent on a firm's ability to determine clear and unambiguous rationales for outsourcing specific innovation activity.

comparison with extant knowledge: Survey results support existing knowledge which displays that firms identify a clear rationale for outsourcing innovation (Howells et al., 2008) (Cass, 2007). Results also display that firms clearly differentiate between a 'cost reduction' rationale and other rationales which ultimately improve profits (Bengtsson et al., 2009).

7.4.2.3 c4. location choice

Expected performance through innovation outsourcing is dependent on a firm's ability to determine the level of various proximities, (i.e., spatial, organisational, cultural, and professional), associated with supplier/partner location.

comparison with extant knowledge: Survey results support existing knowledge which identifies that capability for managing supplier/partner locations is more than the ability to identify and manage geographical distance. It also involves the ability to identify and manage 'psychic' distance, (i.e., language, culture and business practices) (Martinez-Noya et al., 2012) (Grimaldi et al., 2010).

7.4.2.4 c5. mode of outsourcing

Expected performance through innovation outsourcing is dependent on the ability to align the mode of outsourced innovation to a firm's strategic needs.

comparison with extant knowledge: Survey results support existing knowledge which identifies that the choice of innovation outsourcing mode should be aligned to the strategic needs of a firm (Baloh et al., 2008).

7.4.2.5 c6. pool of providers

Expected performance through innovation outsourcing is moderated by the ability to develop and maintain a large and diverse pool of potential innovation outsourcing partners/providers.

comparison with extant knowledge: Survey results add to existing knowledge by displaying that a lack of appropriate and available innovation outsourcing partners/providers results in lost innovation opportunity, and consequently, lower performance. This is especially so in industries susceptible to rapid and frequent change in their business environment due to, for example, new technologies or legislation.

7.4.2.6 c7. provider selection

Expected performance through innovation outsourcing is moderated by the ability to develop and use a comprehensive multi-criteria decision-making framework for selecting the most suitable innovation outsourcing partner/provider.

comparison with extant knowledge: Survey results support existing knowledge which identifies the need to use a broad and balanced range of criteria, both formal and informal, for selecting appropriate partners/providers (Chen and Hung, 2010) (Cui et al., 2009). Formal selection criteria emphasised the protection of intellectual property (Wu et al., 2013) (Kloyer and Scholderer, 2012), and finance. Informal criteria, (e.g., trust), were used to build strong relationships (Tucker and John, 2012) (Ford et al., 2012).

7.4.2.7 c9a, c9c, c9d. degree & alignment of modularity

Expected performance through innovation outsourcing is moderated by the ability to determine and align appropriate levels of modularities, (i.e., product/service architecture modularity, and; organisational design modularity).

comparison with extant knowledge: Survey results support existing knowledge which displays the need for appropriate levels of product/service architecture and organisational design modularity that are aligned to the innovation activity being outsourced (Grote and Taube, 2007) (Baldwin and Clark, 1997) (Hayashi, 2008) (Stephan et al., 2008) (Zirpoli and Becker, 2011a).

7.4.2.8 c10a to c10c. degree of flexibility

Expected performance through innovation outsourcing is dependent on the flexibility of: information technology structures; firm finance procedures, and; innovation employment intensity.

comparison with extant knowledge: Survey results both support and add to existing knowledge concerning c10a, c10b, and c10c.

IT flexibility (c10a): Survey results support existing knowledge which displays that the efficiency and effectiveness of innovation outsourcing is aided by flexible firm structures and procedures relating to information technology (Massini and Miozzo, 2012) (Barczak et al., 2008) (Hempell and Zwick, 2008).

finance flexibility (c10b): Survey results support existing knowledge which displays that the efficiency and effectiveness of innovation outsourcing is aided by flexible firm structures and procedures relating to finance (Hempell and Zwick, 2008).

employee flexibility (c10c): Survey results support existing knowledge which displays that the efficiency and effectiveness of innovation outsourcing is aided by flexible firm structures and procedures relating to employee intensity (Wouters, 2010) (Hempell and Zwick, 2008) (Teirlinck et al., 2010).

complementary/substitutive innovation & flexibility: Survey results add to existing knowledge by identifying that differing degrees of flexibility relating to information technology structures, firm finance procedures, and innovation employment intensity are required depending on whether the outsourced innovation activity is complementary or substitutive.

7.4.2.9 c11a to c11c. governance & control

Expected performance through innovation outsourcing is dependent on the ability to develop and balance formal and informal governance & control when outsourcing innovation.

comparison with extant knowledge: Survey results support existing knowledge which displays the need to develop and use a balance of both formal and informal governance & control routines and procedures when outsourcing innovation (Roy and Sivakumar, 2012) (Roy and Sivakumar, 2011) (Fitzpatrick and DiLullo, 2005) (Li et al., 2008) (Howard and Squire, 2007).

Survey results display that firms use formal routines as the foundation on which innovation outsourcing relationships are developed, but then supplement

these with informal routines as they see fit. Firms cited trust (Plewa and Quester, 2006), and peripheral knowledge (Tiwana and Keil, 2007) as particular examples of informal controlled used.

7.4.2.10 c12. organisational culture

Expected performance through innovation outsourcing is dependent on the development and nurturing of subcultures appropriate to the innovation activity being outsourced.

comparison with extant knowledge: Survey results support existing knowledge. Firms understand that successful innovation outsourcing requires organisational subcultures different to that for developing innovations internally (Mortara et al., 2010) (Munsch, 2004). They appreciate that inappropriate subcultures has the ability to suppress absorptive capacity (Rothaermel et al., 2006), making the integration of knowledge a struggle, resulting in lower performance. Consequently, firms are prepared to undertake deliberate interventions to ensure appropriate subcultures are developed for outsourcing innovation (Kleyn et al., 2007) (Zenger and Lazzarini, 2004).

Survey results add to existing knowledge by emphasising the need to 'measure' culture both before and after interventions to ensure that any changes take effect.

7.4.2.11 c13a to c13c. day-to-day management

Expected performance through innovation outsourcing is: moderated by the ability to manage innovation outsourcing through projects; dependent on the ability to understand what constitutes knowledge and control its flow across boundaries; dependent on the ability to learn by combining new architectural and component knowledge with prior knowledge.

comparison with extant knowledge: Survey results both support and add to existing knowledge concerning c13a, c13b, and c13c.

managing through projects (c13a): Survey results support existing knowledge concerning the use of project management skills specific to technology development with external partners/providers to support innovation outsourcing (Cui et al., 2009). They also support the need for a broad range of skills necessary for successfully managing outsourced innovation projects, i.e., resource management, understanding strategic value, customer insight, technological & organisational skills; managing R&D culture, communication & cooperation, and social responsibility (Flipse et al., 2013). Outsourced innovation requires individual managers with a high degree of skill.

Survey results add to existing knowledge by identifying a multi-tiered approach for successfully managing outsourced innovation projects. This approach distributes the day-to-day management of outsourced projects amongst key managers who liaise directly with their counterparts. This addresses potential difficulties in recruiting highly-skilled project managers experienced in managing outsourced innovation.

managing knowledge (c13b): Knowledge associated with innovation products/services is not completely decomposable (Paoli and Prencipe, 1999). Consequently, there is a risk of firms, inadvertently, transferring proprietary knowledge to suppliers in outsourcing relationships.

Survey results add to existing knowledge by identifying the high cost of innovation outsourcing relationships especially in managerial time and energy. There is a need to ensure sufficient flow of information between a firm and their partners/providers so that innovation outsourcing objectives are met, whilst being careful not to, inadvertently, divulge important information. A firm within the survey addressed this issue by ensuring experienced managers always accompanied less-experienced employees when meeting with outsourced innovation suppliers.

The above issue is also identified by (Martinez-Noya et al., 2013) who suggest that firms need to, firstly, assess the need to transfer proprietary knowledge to suppliers, and; secondly, identify the supplier's opportunity for exploiting the acquired knowledge. It is suggested that firms invest less in relationships where the risk of appropriation is high and adjust behaviour by being less cooperative.

managing learning (c13c): Survey results support existing knowledge which identifies the need for a focus on absorptive capacity (Lowman et al., 2012). They also support the need to ensure that the outcomes of outsourced innovation activity are efficiently disseminated and effectively integrated in to the firm's existing knowledge base (Zirpoli and Becker, 2011a) (Zirpoli and Becker, 2011b). Survey results display a particular emphasis on the need to disseminate tacit knowledge to promote effective learning (Ford et al., 2012).

7.5 Summary

Interview survey data has been analysed and used to deductively test the process and capabilities propositions which form a preliminary generic holistic innovation outsourcing model. A process of pattern-matching and explanation building is used to validate the propositions and explain anomalies. The outcome is a validated generic holistic model for outsourcing innovation to address this study's primary research question, 'how can firms successfully outsource innovation'?

Findings concerning the overall innovation outsourcing process and its associated capabilities have been summarised and discussed.

Chapter 8

Conclusions

This chapter summarises the programme of research and its contributions to research. These are discussed to fulfil research objective 3, i.e., to 'discuss the potential benefits of utilising the model to outsource innovation'. Limitations of research are identified and directions for future work suggested.

8.1 Programme of research

This study's research aim has been to:

> *Develop a generic holistic model to aid firms to successfully outsource innovation.*

which has been fulfilled through the following research objectives:

1. Undertake a state-of-the-art review to define a baseline of knowledge relating to innovation outsourcing as a management discipline.
2. Develop a validated holistic model through the identification & organisation, and refinement of innovation outsourcing capabilities for performance.
   (a) Inductively develop an archetype framework for successfully outsourcing innovation.
   (b) Develop a preliminary innovation outsourcing model by exploring the framework to identify the associations between capabilities and performance.

(c) Design and administer a survey to gather appropriate data with which to test the preliminary model.

(d) Analyse the results of the survey to deductively validate & refine the model.

3. Discuss the potential benefits of utilising the model to outsource innovation.

by executing a programme of research comprising a two stage inductive/deductive process of descriptive theory-building illustrated in Fig. 8.1.

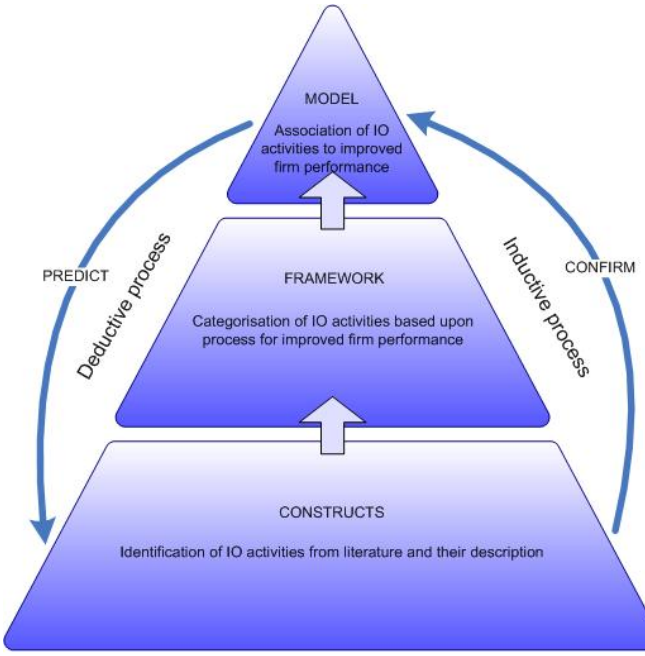


Figure 8.1: Building descriptive innovation outsourcing theory

Stage 1 - Development of preliminary model through induction: This initial stage developed a preliminary model of innovation outsourcing. Template analysis was used to inductively develop an innovation outsourcing archetype framework from a literature data set, (chapter 4). The framework was then explored using influence diagrams to make explicit the associations between innova-

tion outsourcing process, capabilities and performance to produce a preliminary model of innovation outsourcing, (chapter 5).

Stage 2 - Validation and refinement of model through deduction: This stage validated and refined the preliminary model of innovation outsourcing. An interview survey protocol and instrument reflecting the preliminary innovation outsourcing model as rich pictures was developed for use as part of a semi-structured interview survey, (chapter 6). The data collected from the survey was used to deductively validate and refine the preliminary model of innovation outsourcing through a process of analysis using pattern matching and explanation building (chapter 7). The outcome was a validated model of innovation outsourcing.

8.2 Primary research contribution

This study's primary contribution arises directly from the outcome of its research aim, which is a validated generic holistic model to aid firms to successfully outsource innovation.

The model, (illustrated in Fig. 8.2), is represented as a three stage process involving, the determination of innovation activity to be outsourced, (i.e., selection); the deployment of innovation to be outsourced, (i.e., deployment), and; the management of outsourced innovation, (i.e., implementation). It is explained through statements of correlation between its structure & process, and constituent capabilities, to performance, i.e., statements p1-p8, and c1-c13. The statements are integral to the model and provide an understanding of the process and capabilities required to successfully outsource innovation and realise performance.

The significance of the model is detailed below in terms of its contributions to both the theory and practice of innovation outsourcing.

8.3 Contribution to theory

This study provides key contributions to the theory of innovation outsourcing.

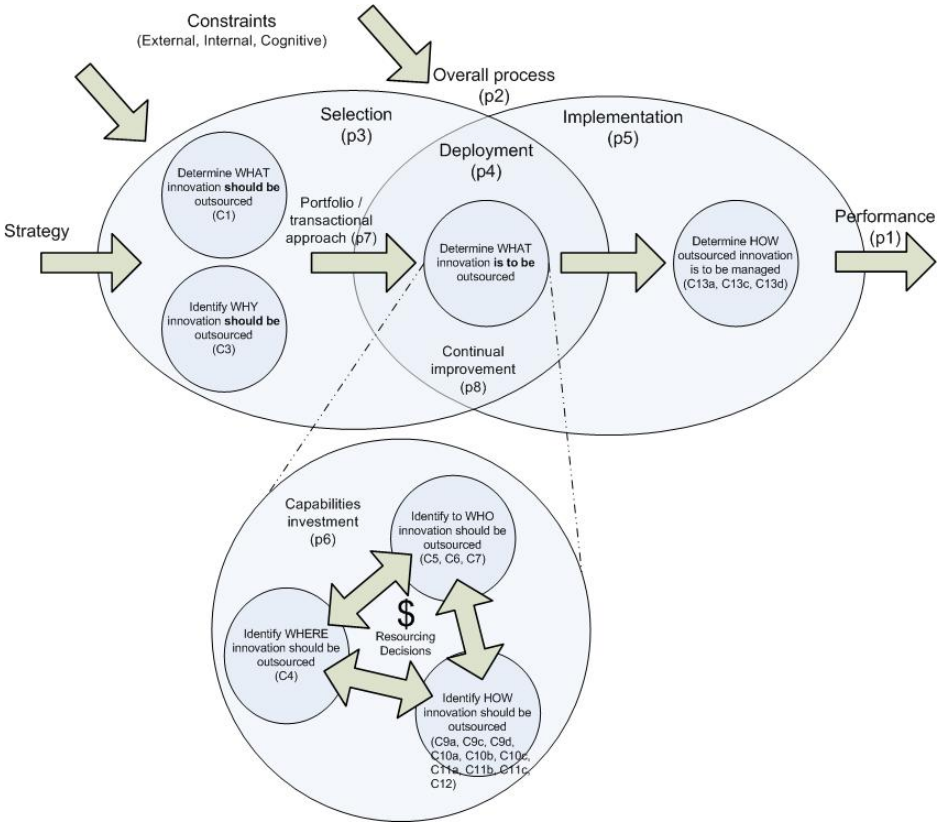


Figure 8.2: Overall innovation outsourcing process

Definition of innovation outsourcing: Firstly, using a structured and stepwise approach for organising and integrating the extant literature, this study identifies innovation outsourcing as a complex multi-faceted concept comprising various characteristics encompassing several theoretical foundations. It also identified that there does not exist a widely accepted definition of innovation outsourcing. The characteristics of innovation outsourcing were elucidated from existing knowledge to construct a clear generic definition:

> *'a strategic decision involving the antecedents, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries'*

How management and employees define and understand innovation outsourcing forms the foundation of their actions. It is important, therefore, that a clear and

unambiguous definition of innovation outsourcing is shared as widely as possible within an organisation and amongst partner/supplier organisations.

Holistic innovation outsourcing: Secondly, through the development of a holistic model this study addresses key gaps in knowledge that were identified in section 2.9 Key findings & knowledge gaps of Chapter 2, Review of Literature. The gaps concern incomplete innovation outsourcing theory from a management perspective and the lack of a capabilities framework for managing innovation outsourcing.

8.3.1 Innovation outsourcing management

The validated generic holistic model developed by this study consolidates current understanding of innovation outsourcing and extends it, specificlly, regarding the role of management. In particular, this study adds to existing knowledge in relation to: systems, utility & value, and the integration of strategic management perspectives within an overall innovation outsourcing process.

This study's contributions to innovation outsourcing management theory relate to process. They are summarised in Table 8.1, and displayed within the model, Fig. 8.2, as innovation outsourcing process capabilities p1-p8.

8.3.1.1 An open system

The model developed by this study describes innovation outsourcing as an open system of interrelated activities that takes firm strategy, (in terms of people, organisational structures, environment, and technology), as its input to transform it in to improved firm performance through innovation.

This study is the first to consider innovation outsourcing as a system. In doing so, it has enabled a more complete view of innovation outsourcing management than is currently available. Despite innovation outsourcing being a complex multi-faceted concept comprising various characteristics encompassing several theoretical foundations, existing studies have tended towards a narrow focus, concerned only with one or a few aspects of innovation outsourcing.

INNOVATION OUTSOURCING PROCESS CAPABILITY	
PROCESS	p1. Performance outcome
	p2. Overall process for outsourcing innovation
SELECTION	p3. Selection stage
	p7. Portfolio / transactional approach
DEPLOYMENT	p4. Deployment stage
	p6. Capabilities investment
	p8. Continual improvement
IMPLEMENTATION	p5. Implementation stage

Table 8.1: Innovation outsourcing process capabilities

8.3.1.2 Description of performance, p1

This study provides an explicit description of how performance through innovation outsourcing is managed. Performance is managed by ensuring that the total utility of innovation outsourcing benefits outweigh the costs of achieving the delivered benefits. The basis of this statement is the value concept which has its foundations in utility theory (Lancaster, 1971) and is widely used in various contexts, including business strategy, marketing and economics (McIvor, 2005).

Whilst the extant literature makes reference to the term 'performance' in the context of innovation outsourcing it does not explain the term, nor explain how it is to be realised. Instead, innovation outsourcing studies tend to assume firm performance as an outcome, focusing on the expected benefits (Amaral et al., 2011) (Howells et al., 2008) (Piachaud, 2002) with consideration of only a limited set of capabilities necessary for realising performance. The review of literature identified seven papers that considered the complete innovation outsourcing process. These papers, whilst referring to firm performance, do not explain the term, nor describe how it is to be realised.

This study's statement of how performance through innovation outsourcing is managed addresses a notable criticism within the extant innovation outsourcing

literature which is the lack of an explicit focus on firm performance, '... we far better understand why companies expect to profit from outsourcing R&D as compared with how they actually benefit' (Hsuan and Mahnke, 2011).

8.3.1.3 Overall innovation outsourcing process, p2

This study identifies managing innovation outsourcing for performance as a three stage process that is constrained by its environment. The three stages of the process involve: determining the innovation activity to be outsourced, (i.e., selection); deploying innovation to be outsourced, (i.e., deployment), and; managing outsourced innovation, (i.e., implementation). The environmental constraints comprise external, internal, and cognitive elements.

Environmental constraints: Whilst several studies, e.g., (Chang et al., 2009) (Zirpoli and Becker, 2011a), have drawn attention to the need to consider the influences of the global environment when outsourcing innovation, this study makes an explicit association between firm performance through innovation outsourcing and its broader environment.

This study is the first to identify, collate and categorise the environmental influences on innovation outsourcing. Each influence has the potential to limit a firm's performance if it is not appropriately considered as part of its strategy when outsourcing innovation. These constraints are categorised as: external to the firm, (e.g., globalisation, uncertainty, etc.); internal to the firm, (e.g., firm size, learning, etc.), and; cognitive, (e.g., external R&D as substitute/complement, commitment, etc.).

External constraints highlight the strategic management perspective of the industry view, (IV), which concerns the relationship between the firm and its external environment, in particular, the industry in which it competes. The performance potential of the firm through innovation outsourcing is influenced by the structural characteristics of the industry in which it competes (Porter, 1980), and how it sees the world with respect to external factors such as globalisation, uncertainty, new economic paradigms, global talent pools and global legal regimes.

Internal and cognitive constraints highlight the strategic management perspective of the resourced based view, (RBV), which concerns the relationship between the firm and its internal environment. The performance of a firm is influenced by the competitive advantage that it realises through the distinctiveness of its capabiities for outsourcing innovation (Prahalad and Hamel, 1990).

Three stage management subsystem: This study's three stage, (selection, deployment and implementation), process for managing innovation outsourcing contrasts with existing knowledge which views the innovation outsourcing process simplistically as two discrete and independent steps of selection and implementation (Cui and Loch, 2011) (Murray et al., 2009), which disregard the need for ascertaining and deploying appropriate firm structures and procedures for managing the specific risks associated with innovation outsourcing.

The three management stages of the model identify factors which display that performance through innovation outsourcing requires the consideration of four strategic management perspectives and their interdependencies, i.e.: the industry view (IV), transaction cost economics (TCE), the resource based view (RBV), and the relational view (RV).

In contrast, the majority of papers that consider the complete innovation outsourcing process reference only the RBV in terms of the specific capabilities necessary for particular performance outcomes (Zirpoli and Becker, 2011a) (Zirpoli and Becker, 2011b) (Ciravegna and Maielli, 2011) (Bengtsson et al., 2009). The IV and RBV are referenced by (Roy and Sivakumar, 2011) as influences for the management of intellectual property when outsourcing innovation. The RV is emphasised by (Azadegan and Dooley, 2010) in terms of aligning learning styles for particular performance outcomes. Only (Chang et al., 2009) considers the innovation outsourcing process in terms of industry-specific factors, firm-specific factors and governance specific factors which refer to the IV, RBV and TCE respectively.

8.3.1.4 Selection, p3

This study identifies that performance and its management entails determining what innovation *should be* outsourced and why it *should be* outsourced. This

is illustrated within the model as the selection stage and is based on the RBV, theory of core competencies and utility theory.

This definition of selection draws a clear distinction between what *should be* outsourced and what can actually be outsourced. If performance is to be managed, determining what innovation *is to be* outsourced can only be undertaken after consideration of the potential costs of outsourcing innovation. Exisiting studies only define selection in terms of differentiating core capabilities from non-core capabilities. They are unable to draw the distinction between what should be outsourced and what can actually be outsourced due to their lack of focus on performance.

Determining what innovation *should be* outsourced involves differentiating innovation activity based on its association with core capabilities. This is because performance of a firm is influenced by the competitive advantage that it realises through the distinctiveness of its capabiities. Innovation activity associated with core capabilities is retained within the firm, whilst remaining activity is considered for outsourcing, enabling a distinct internal/external boundary of innovation activity to be defined.

Determining why innovation *should be* outsourced involves ascertaining the utility of innovation activity in terms of its nature, (i.e., minimising cost or maximising profit), and scale. Utility enables value, and consequently, performance of innovation outsourcing to be determined.

Selection may be initiated by either 'what innovation should be outsourced' or 'why it should be outsourced', but one must be aligned to the other.

8.3.1.5 Deployment, p4

This study identifies that performance and its management entails the alignment of a firm's innovation outsourcing capability to the innovation activity that *should be* outsourced. Only innovation activity that can be aligned to capability is able to be outsourced successfully, defining what innovation *is to be* outsourced. This is illustrated within the model as the deployment stage.

Alignment, firstly, involves the consideration of various relevant capabilities required for potentially outsourcing innovation activity. Secondly, it involves

deciding whether to invest in resources to rectify any shortfall in capability. This is achieved by weighing any costs against the utility of innovation activity to determine the value of outsourcing. The deployment stage is able to undertake this pivotal role in the innovation outsourcing management subsystem because it interfaces to various capabilities enabling effective outsourcing decisions to be made.

The interface of the deployment stage to various capabilities displays that the outsourcing decision is not explained solely in terms of TCE, but by the interdependence between and integration of the strategic management perspectives, TCE, RBV, RV, and IV. This is outlined below.

TCE: The model displays that the decision to outsource innovation is dependent on performance which is achieved through value, where the utility, (identified through 'why innovation *should be* outsourced'), of outsourced innovation activity is greater than the costs of outsourcing.

Within the deployment stage, determining where and to whom innovation is outsourced concerns capability for making choices for the location and provider of innovation products and services. It forms the relationship between the firm and the market place in terms of the innovation outsourcing transaction.

TCE – IV: The model displays that the decision to outsource innovation, (TCE), is dependent on the consideration of external industry factors, (IV), (e.g., globalisation and uncertainty), which have the potential to constrain performance.

TCE – RBV: The model displays, (through determining 'what innovation *should be* outsourced'), that the decision to outsource innovation, (TCE), is dependent on differentiating non-core innovation activity from core innovation activity, (RBV).

The model also displays that the decision to outsource innovation, (TCE), is dependent on making effective resourcing decisions which aligns innovation outsourcing capability to the innovation activity that *should be* outsourced, (RBV).

The model further displays that the continual identification, resourcing and development of capabilities aligned to the innovation activity being outsourced, (TCE), enables the dynamic building of organisational, functional and technological skills which are adaptive and difficult to imitate (RBV).

TCE – RV: The model displays through the implementation stage that the decision to outsource innovation, (TCE), is dependent on the day-to-day management, (RV), of outsourced innovation activity. Cultivating relationships with external organisations to access specific skills and knowledge has the potential to create valuable and difficult-to-imitate innovations.

TCE – RBV, RV: The model displays that the decision to outsource innovation, (TCE), is dependent on making effective resourcing decisions which aligns innovation outsourcing capability to outsourced innovation activity. Innovation outsourcing capability includes those routines, processes and infrastructure required for managing innovation outsourcing both within the firm, (RBV), and across firm boundaries, (RV).

TCE – IV, RBV, RV: The model displays that the decision to outsource innovation, (TCE), requires the consideration of external industry factors, (IV), when making investment decisions to develop resources for use either within the firm, (RBV), or beween firms, (RV).

8.3.1.6 Implementation stage, p5

This study identifies that performance and its management entails the day-to-day management of outsourced innovation. Performance is moderated by the ability to manage the multi-faceted aspects of day-to-day outsourced innovation, which includes: managing innovation outsourcing through projects; understanding what constitutes knowledge and controlling its flow across boundaries, and; managing learning by enabling the combining of new architectural and component knowledge with prior knowledge.

8.3.1.7 Investment in capabilities, p6

This study identifies that innovation outsourcing performance is positively associated with making *appropriate* investment decisions which align innovation outsourcing capabilities to the innovation activity being outsourced. The term 'appropriate' is emphasised; whilst sufficient consideration and investment in innovation outsourcing capabilities aids performance, insufficient consideration and investment in capabilities moderates performance due to lost opportunity. It can also be inferred that over-investment in innovation outsourcing capabilities is negatively associated with performance. Performance requires the alignment of outsourcing capability to the innovation activity that is to be outsourced.

This study's systems-led approach has identified that there exist various capabilities necessary for outsourcing innovation across its three stages; selection, deployment and implementation. For performance, there must exist sufficient capability for outsourcing the proposed innovation activity. If there is insufficient capability, a judgement on whether investing in additional capability justifies the benefits to be gained from outsourcing is required to be made. Performance requires that the benefits to be gained from outsourcing exceeds the cost of investing in additional capability. Where the costs of investing in additional capability exceeds the benefits to be gained from outsourcing, the proposed outsourcing of the innovation activity is required to be reviewed.

Existing knowledge concerning innovation outsourcing capability and performance tends to refer only to the protection of intellectual property and the increased risks that are posed where there is insufficient capability to prevent IP leakage (Piachaud, 2002).

8.3.1.8 Portfolio/transactional approach, p7

This study identifies and explains the use of a portfolio or transactional approach when outsourcing innovation.

Typically, a portfolio approach may be used when outsourcing innovation in a stable environment, which is explained by the RBV. A portfolio approach enables a firm's list of potentially outsourced innovation activity to be evaluated and

prioritised prior to the allocation of resources, offering the advantage of strategic alignment, maximisation of value and the balance of risk & reward.

Despite the advantages of using a portfolio approach, this study presented evidence for the use of a transactional approach for outsourcing innovation. This cannot be explained solely through the theory of TCE, which asserts that firm's should either develop the capability internally or acquire an organisation with the capability. It is explained through a combination of TCE and RBV, which asserts that it is prudent to outsource when the cost of either developing internal capablity or acquiring an organisation with the capability is too high; opportunism is viewed, simply, as part of the cost of gaining access to specific capabilities (Barney, 1999). This study identified that firm's, typically, adopting a discrete transactional approach to innovation outsourcing were SMEs, (small to medium-sized enterprises), who tend not to possess the same level of resources as larger global organisations which, typically, adopt a portfolio approach.

In addition to the above, this study identifies that use of a transactional approach may also be due to a firm's external environment. Firm's operating in a dynamic and competitive market may be required to continually respond immediately to a need where there is a narrow window of opportunity for bringing a product to market before it becomes obsolete. This is explained through through a combination of TCE, RBV, and IV.

The model displays that the selection of innovation activity to be outsourced may be initiatiated with either the 'what' or 'why' tasks. Initiating the selection of innovation activity with the 'what' task is consistent with a portfolio approach, whilst initiating the selection of innovation activity with the 'why' task is consistent with a transactional approach.

Existing studies do not address the use of a portfolio or transactional approach when outsourcing innovation.

8.3.1.9 Continual improvement, p8

This study identifies that the continual identification, resourcing and development of capabilities aligned to the innovation activity being outsourced is positively associated with sustained performance.

Through the innovation model this study describes a mechanism for sustained performance. The alignment of outsourcing capability to outsourced innovation activity is necessary for performance. Across the three stages, (selection, deployment and implementation), capabilities are required to be examined to identify whether they are sufficient for the successful outsourcing of any proposed innovation activity. Where there exists a deficit, additional capability is required to be developed prior to outsourcing, as long as the benefits outweigh the costs. This continual focus on performance and capabilities enables the dynamic building of organisational, functional and technological skills which are adaptive and difficult to imitate.

This study is the first to associate sustained performance with the need to continually review innovation outsourcing capability.

8.3.2 A capabilities framework

A capabilities framework for managing innovation outsourcing is developed by this study to address a key gap in knowledge identified from the review of literature. It is presented below as Table 8.2. The capabilities framework comprises a set of specific capabilities, (c1-c13), associated with innovation outsourcing performance which are structured according to their role, (i.e., what, why, where, to whom, and how innovation is outsourced & managed day-to-day), within the three stages of the innovation outsourcing process, (i.e., selection, deployment, and implementation). Each capability and its corresponding role is the outcome of validation through the analysis of survey data.

The framework has been developed using a systems-led contingency approach, and is presented as a portfolio of capabilities. It reflects that there is no one best way to manage innovation outsourcing and that managerial decisions for effective firm performance are dependent on the nature of the environment in which the organisation operates.

The framework comprises a more comprehensive set of capabilities with greater breadth across the innovation outsourcing process than exists within the extant literature, for example, (Zirpoli and Becker, 2011a) (Zirpoli and Becker, 2011b)

INNOVATION OUTSOURCING CAPABILITY		
SELECTION	WHAT	c1. Differentiating core & non-core activity
	WHY	c3. Clarity of rationale
DEPLOYMENT	WHERE	c4. Location choice
	to WHO	c5. Mode of outsourcing
	to WHO	c6. Pool of providers
	to WHO	c7. Provider selection
	HOW	c9a. Product / service architecture modularity
	HOW	c9c. Organisational design modularity
	HOW	c9d. Alignment of modularities
	HOW	c10a. Information technology flexibility
	HOW	c10b. Finance flexibility
	HOW	c10c. Employment intensity flexibility
	HOW	c11a., c11b & c11c. governance & control
	HOW	c12. Organisational culture
IMPLEMENTATION	HOW	c13a. Management through projects
	HOW	c13b. Knowledge management
	HOW	c13c. Learning management

Table 8.2: Innovation outsourcing capabilities

(Ciravegna and Maielli, 2011) focus only on capabilities to manage modularity, knowledge and learning.

This study's contribution to the current understanding of individual capabilities for outsourcing innovation is summarised below.

8.3.2.1 Pool of providers, c6

This study identifies that innovation outsourcing performance is moderated by the ability to develop and maintain a large and diverse pool of potential innovation outsourcing partners/providers.

Firms that proactively develop and maintain a pool of potential providers are able to respond rapidly to new opportunities for which they need capabilities that aren't immediately available within the firm. In contrast, firm's that do not invest in developing a pool of potential providers accumulate potential innovation projects that they are unable to fulfil, possibly resulting in lost opportunities.

This capability is especially pertinent to industries susceptible to rapid and frequent change in their business environment due to, for example, new technologies or legislation.

8.3.2.2 Degree of flexibility, c10a to c10c

Innovation outsourcing performance is dependent on the flexibility of: information technology structures (Massini and Miozzo, 2012); firm finance procedures (Hempell and Zwick, 2008), and; innovation employment intensity (Wouters, 2010).

Whilst this study's analysis supports the above, it also identifies that differing degrees of flexibility are required depending on whether the nature of the outsourced innovation activity is complementary or substitutive. Firms substituting innovation activity require greater flexibility in their existing information technology, finance and employee infrastructure than those firms that complement their innovation activity.

This study's analysis identifies that firms complementing existing innovation activity with that sourced from outside their boundaries, typically, do not review nor enhance the flexibility of existing structures and procedures. This is because complementary innovation activity tends to be incremental in nature, and existing information technology, finance and employee infrastructure seem to be sufficiently flexible to cope with smaller scale demands.

In contrast, firms substituting existing innovation activity with that sourced from outside their boundaries, typically, undertake a broad review of the scale and function of firm infrastructure, including information technology, finance procedures and number of employees. This is because the decision to transfer innovation activity from within a firm is often accompanied by significant change to organisational design.

8.3.2.3 Organisational culture, c12

Performance through innovation outsourcing is dependent on the development and nurturing of subcultures appropriate to the innovation activity being outsourced (Mortara et al., 2010) (Rothaermel et al., 2006) (Kleyn et al., 2007). This study adds to the current understanding of organisational culture when outsourcing innovation by emphasising the need to 'measure' culture both before and after interventions to ensure that any changes take effect.

8.3.2.4 Managing through projects, c13a

Performance through innovation outsourcing is moderated by the ability to manage outsourced innovation through projects (Cui et al., 2009) (Flipse et al., 2013).

Ensuring that outsourced innovation objectives are achieved involves the day-to-day management of various factors, including: innovation activity, schedules, quality, decisions, attitudes, skills, stakeholders, teams, contracts, finance, communication, risk, etc. In order to handle the inherent complexity and uncertainty of outsourced innovation, managing through projects is recommended. This requires individual managers with a high degree of skill who are limited in supply.

To address potential difficulties in recruiting highly-skilled project managers experienced in managing outsourced innovation, this study identifies that firms tend to adopt a multi-tiered approach for successfully managing outsourced innovation projects. This approach distributes the day-to-day management of outsourced projects amongst key managers who liaise directly with their counterparts.

8.3.2.5 Managing knowledge, c13b

Performance through innovation outsourcing is dependent on the ability to understand what constitutes knowledge and control its flow across boundaries (Martinez-Noya et al., 2013) (Paoli and Prencipe, 1999).

Communication with partners/suppliers is an inherent aspect of outsourced innovation. Due to the incomplete decomposability of knowledge associated with innovation products/services, there exists a risk of inadvertently transferring proprietary knowledge to suppliers in outsourcing relationships. This study identifies

that this issue may be overcome by ensuring that experienced managers always accompany less-experienced employees when meeting with outsourced innovation suppliers.

8.4 Contribution to practice

The key aspects of the model which aids managers when outsourcing innovation are discussed below.

8.4.1 A shared understanding

The holistic model promotes a shared understanding (Mihalache et al., 2012) of what innovation outsourcing entails in terms of its capabilities and process. This is especially important for garnering management support which is widely accepted as necessary for innovation outsourcing to be successful (Amaral et al., 2011) (Mortara et al., 2010). This was also a theme that was universally voiced by interviewees during the survey, e.g., *'buy-in from leadership is essential.' [07-peng-tech].*

8.4.2 A focus on performance

The holistic model enables a focus on performance. A significant criticism of managers when outsourcing innovation is that they tend to focus on expected benefits rather than actual outcomes. This is also a criticism of much innovation outsourcing research, '... we far better understand why companies expect to profit from outsourcing R&D as compared with how they actually benefit.' (Hsuan and Mahnke, 2011).

The holistic model has been developed with a focus on performance from the outset, associating both capabilities and how they are organised, i.e., process, to performance. Consequently, its use concentrates minds on making innovation outsourcing decisions for actual outcomes.

8.4.3 Effective 'selection' decisions

The 'selection' stage of the holistic model encapsulates some key requirements for successfully outsourcing innovation enabling better decisions.

clarity of selection: The model promotes clarity in the selection of innovation activity to be outsourced. Managers are required to clearly identify what innovation activity they can potentially outsource, and their rationale for doing so. Without knowing what innovation activity is important to them and what is not, they risk the potential loss of core competencies or a lack of operational efficiency. Without knowing why they are seeking to outsource innovation activity, managers are unable to determine how to measure the potential benefit to be gained from outsourcing. The rationale for outsourcing is required to be specific to the innovation activity to be outsourced.

flexibility: The model promotes flexibility in the selection procedure, and subsequent process for outsourcing innovation. It enables either a transactional or portfolio approach to be adopted. The selection stage can be initiated either by determining 'what innovation activity is to be outsourced' or 'why it is to be outsourced', but they must be aligned to each other. Initiating selection with 'what innovation activity is to be outsourced' is consistent with a portfolio approach, whilst initiating selection with 'why innovation activity is to be outsourced' is consistent with a transactional approach.

alignment with deployment/implementation capabilities: The model supports the achievement of innovation outsourcing objectives by ensuring the need for appropriate capabilities prior to outsourcing. The overlap of the implementation stage with the selection stage highlights the interdependency between innovation activity that can potentially be outsourced and the need for appropriate capabilities to ensure innovation outsourcing objectives are met. Innovation activity selected to be outsourced should not be outsourced without the appropriate deployment/implementation capabilities.

hygiene capabilities The model identifies the minimum set of capabilities that a firm must possess and invest in to engage in outsourcing innovation. These are termed hygiene capabilities and are represented by the capabilities necessary for selecting innovation activity that can potentially be outsourced.

8.4.4 Effective 'deployment' decisions

The 'deployment' stage of the holistic model encapsulates some key requirements for successfully outsourcing innovation enabling better decisions.

capabilities investment: The model supports effective investment decisions in innovation outsourcing capabilities. Displaying its central role, the deployment stage is defined by the overlap between the selection and implementation stages. Comprising the structures and procedures necessary to support the implementation of outsourced innovation activity, it represents the distinction between innovation activity that can *potentially* be outsourced and that which can *actually* be outsourced. This distinction enables investment decisions to be focused only on those capabilities necessary to support outsourced innovation.

development of innovation outsourcing as a strategic advantage: The model supports the development of innovation outsourcing as a strategic advantage. The deployment stage of the model, importantly, displays the need for ascertaining and deploying appropriate firm structures and procedures for managing the specific risks associated with innovation outsourcing. These deliberate interventions support the purposeful creation, extension and modification of the firm's innovation outsourcing resource base as dynamic capabilities. Over time, the development of dynamic capabilities has the potential to confer competitive advantage. This supports the notion of innovation outsourcing as a strategic initiative.

stream-lined decisions: The model promotes more stream-lined decisions. The overlap of the selection and implementation stages identifies three distinct but interdependent stages. This highlights that although an outsourcing decision

may relate to a particular stage, execution of the decision is related to decisions made in other stages. This enables quick provisional decisions and effective final decisions to be made when outsourcing innovation.

8.4.5 Effective day-to-day management

The model aids effective day-to-day management of outsourced innovation. Prior to the implementation stage of the model, the 'selection' and 'implementation' stages have ensured that, only innovation activity appropriate for outsourcing is selected, and that it is supported by appropriate structures and procedures. The consequence is fewer potential risks and implementation issues, leading to more effective day-to-day management of outsourced innovation.

8.5 Secondary research contributions

In general, this study's secondary contributions relate to the research process adopted for fulfilling its research aim.

8.5.1 Synthesis of structured methodology for review:

Due to the novelty of the domain there does not exist a comprehensive review, nor a means for conducting a structured review of literature relating to innovation outsourcing. A systematic methodology framework comprising a search, selection and analysis strategy was synthesised from those of related domains. The value of the methodology was displayed in its execution and outcomes.

8.5.2 A baseline of knowledge

This study has provided a baseline of knowledge relating to innovation outsourcing as a management discipline. Innovation outsourcing was identified to be a complex multi-faceted concept comprising various characteristics encompassing several theoretical foundations.

8.5.3 Process for building innovation outsourcing theory

This study has provided a process for building and continually refining descriptive theory relating to managing innovation outsourcing. A general model for building disruptive innovation theory (Christensen, 2006) was adapted and applied to building theory for innovation outsourcing.

Methods and techniques have been specified for both the induction and deduction stages of innovation outsourcing theory building. Template analysis and influence diagrams were used to inductively develop a preliminary innovation outsourcing model. A semi-structured interview survey was used to gather data for validating and refining the model in the deductive stage. Rich pictures, developed using soft systems methodology, aided the eliciting of data regarding a complex domain. Pattern matching & explanation building were used as appropriate analysis techniques.

8.6 Limitations of research

Research quality should be an integral aspect of any research design. Consequently, especial care has been taken throughout this research study to ensure that an acceptable level of quality or 'trustworthiness' (Lincoln and Guba, 1985) has been maintained. Nevertheless, as with all research, it is subject to limitations.

In keeping with the qualitative nature of this study, the limitations of research are discussed in terms of:

1. Credibility - refers to how believable are the findings of a study, similar to internal validity.

2. Transferability - refers to the extent to which findings are applicable to other contexts, similar to external validity.

3. Dependability - refers to whether a study's findings are applicable at other times, similar to reliability.

4. Confirmability - refers to the degree to which a researcher's values have been allowed to intrude in to a study, similar to objectivity.

8.6.1 Credibility of model

This is the extent to which the model is believable in terms of its correlations between process & capabilities to performance, and the extent to which other plausible explanations for performance have been ruled out. Possibly, the best way to establish credibility is to have examined the model from as many different ways as possible, especially as alternative explanations are likely to come from a different viewpoint.

8.6.1.1 Literature data set

Examining the model from as many different ways as possible is aided or limited by particular attributes of the literature data set used to inductively develop the model. These are discussed below.

scale, diversity & quality: The credibility of the model is improved with increased scale, diversity & quality of the source data used to develop the innovation outsourcing model. The review of literature identified a large and diverse number of innovation outsourcing studies over a significant period of time with low specificity. The use of literature provided quick access to data of acceptable quality. The use of primary data was disregarded because the time and level of resources needed to collect a similar scale, diversity and quality of data was prohibitive.

suitability: Credibility of the model is influenced by whether the source data used for its development is suitable, i.e., measurement or construct validity. The suitability of using a literature data set for the purpose of developing a preliminary model was addressed by identifying how other researchers had managed similar scenarios in similar contexts. Support for using a literature data set is provided by (Smith et al., 2008) who uses literature to inductively develop a conceptual model of factors influencing an organisation's ability to manage innovation.

8.6.2 Transferability of model

This is the extent to which the model, in terms of its correlations between process & capabilities to performance, can be trusted to apply to different contexts. This is established by testing the model on different data sets. Transferability of the model is aided or limited by the data set with which it was deductively validated & refined.

8.6.2.1 Interview data set

A degree of transferability for the model is established by validating and refining the model using data collected through a semi-structured interview survey. The influencing factor is the 'quality' of subjects, selected to be interviewed, (in terms of the breadth & depth of their experience and expertise), as the data will be only as good as the responses received. Consequently, careful consideration was given to the selection of interview subjects. The interview data was drawn from eight senior executives and professionals with over 150 years experience in innovation outsourcing. Their experience related to numerous organisations in several industry sectors. The firms ranged in size from SMEs, with a turnover of less than £20m to global conglomerates with £multi-billion turnovers. Different groups of interviewees may provide different or additional insights.

8.6.3 Dependability of model

This is the extent to which the model is applicable at other times. It is a function of how the source data for inductively developing the model and deductively validating the model was collected. Dependability is attained by ensuring that unwanted data is excluded and sufficient relevant data is included.

8.6.3.1 Preliminary model

Dependability of the model is aided by the structured approach adopted for excluding irrelevant data and using only relevant data for building the model. This is achieved at two levels, firstly in the definition of the literature data set and, secondly, in the template coding process to develop the preliminary model.

definition of literature data set: A methodical search of two leading databases of literature within the business and management domains was undertaken to define the base data set. Searches contained the terms 'outsourcing and (R&D or innovation)' and criteria were specified to restrict the search to journal articles, scholarly journals or academic journals and those that are peer reviewed. Each paper was read and studied in detail before categorising them according to particular foci where innovation outsourcing is treated as a discipline used by management to make informed decisions based on a good understanding of the enterprise and its external environment.

template coding process: The template coding process ensured that only relevant data was used for developing the preliminary model. The coding process was started with the most recent paper to mitigate risks due to historical data. It was continued with waves of categorising text, review and reflection.

8.6.3.2 Validation of model

Dependability of the model is aided by the use of an interview protocol and survey instrument to ensure that only relevant data is collected and used for validating the model.

interview protocol & survey instrument: A structured seven stage approach was used as the foundation for the survey design. The structured approach aided the application of dependability checks throughout the inquiry. Dependability was also aided by the use of a rich picture interview survey instrument.

8.6.4 Confirmability of model

The qualitative nature of this study demands that especial care be taken to address the issue of confirmability. It is the extent to which this researcher's values or bias has been allowed to influence the development and validation of the model.

To display that development of the model has been done in 'good faith', an 'auditable' approach was adopted by this study to provide as much transparency

as possible through detailed descriptions of the data and methods used to develop the model. This is summarised below.

literature data set: Detailed descriptions are provided for the synthesis of a structured methodology for conducting a review of innovation outsourcing literature as well as its execution and results. The literature data set provides a data source that is permanent and available in a form that can easily be checked by others (Denscombe, 2007).

theory-building method: A description of the systematic consideration of all the options for identifying a research methodology and design has been provided. A detailed description of the overall inductive/deductive theory-building approach used for developing the model is also given.

preliminary model: Detailed justification for the adoption of a secondary data set in the form of literature. The adoption of template analysis with detailed descriptions of its execution to develop the innovation outsourcing framework. The adoption of influence diagrams to detail the associations between innovation outsourcing constructs which constitute the preliminary model.

validation of model: The use of a structured seven-stage method for the design of a semi-structured interview survey. Detailed descriptions for the development of a rich picture interview survey instrument, and the execution of an interview survey protocol. Descriptions of the methods of analysis and structured presentation of results.

8.7 Future work

There are two main areas of opportunity to progress this study. Firstly, to continue enhancing the innovation outsourcing model, and secondly, to develop a statement of causality for innovation outsourcing performance, i.e., a single notion of what 'causes' performance. These can both be addressed using a process of inductive/deductive theory-building.

8.7.1 Continual development of model

The inductive/deductive descriptive theory-building research design adopted for this study enables the continual development and refinement of the innovation outsourcing model. Each cycle of inductive theory-building enables the creation of additional categories and associations between innovation outsourcing phenomena. These are then tested in further cycles of deductive theory-building. Anomalies are identified and resolved. Each cycle of the theory-building process has the potential to provide further insights into the model.

8.7.2 Development of a statement of causality

The innovation outsourcing model developed by this study is largely descriptive with limited predictive powers. Development of a statement of causality to identify what 'causes' performance would provide enhanced predictive powers, guiding managers with actions they ought to take in particular circumstances.

A statement of causality is developed through a process of normative theory-building which is similar to that for building descriptive-theory, involving steps of observation, categorisation and association. Observation involves identifying and describing the attributes of capabilities which result in performance. These are categorised according to the circumstances that result in innovation outsourcing performance. The circumstances are considered as a whole to formulate a preliminary statement of causality which is subsequently tested using an explicitly normative form of circumstances analysis, e.g., backcasting.

8.8 Conclusions

The primary research question posed by this study was, 'how can firms successfully outsource innovation'? This thesis document has provided a comprehensive response in the form of a generic holistic model of innovation outsourcing. It is explained through statements of correlation between the model's structure and process, and constituent capabilities, to performance. Highlighting the potential benefits of utilising the model enables the following recommendations to be drawn:

1. Make performance the focus of innovation outsourcing aims.
2. Adopt a three stage, (selection, deployment, and implementation), process for outsourcing innovation.
3. Identify all the innovation activity that can *potentially* be outsourced and define clear rationales for doing so.
4. Align outsourced innovation activity to existing capability.
5. Invest in developing capability to outsource potential innovation activity where performance allows.

References

Abecassis-Moedas, C. and Mahmoud-Jouini, S. (2008). Absorptive capacity and source-recipient complementarity in designing new products: An empirically derived framework, *Journal of Product Innovation Management* **25**(5): pp. 473–490. 149, 162

Ackermann, F. and Eden, C. (2001). Journey making and mapping in practice, *in* J. Rosenhead and J. Mingers (eds), *Rational Analysis in a Problematic World Revisited*, Wiley, London, pp. 43–60. 96

Albors-Garrigos, J., Etxebarria, N., Hervas-Oliver, J. and Epelde, J. (2011). Outsourced innovation in SMEs: a field study of R&D units in Spain, *International Journal of Technology Management* **55**(1/2): pp. 138–155. 31, 58

Allaboutandroid (2012). Android eating Apple.
URL: *http://www.allaboutandroid.gr/?attachment_id=2466* 2

AlShalabi, A. and Rundquist, J. (2009). Use of processes and methods in NPD – a survey of Malaysian industry, *International Journal of Innovation & Technology Management* **6**(4): pp. 379–400. 145

Amaral, J., Anderson, E. and Parker, G. (2011). Putting it together: How to succeed in distributed product development, *MIT Sloan Management Review* **52**(2): pp. 51–58. 31, 32, 33, 34, 35, 57, 58, 111, 117, 132, 133, 137, 138, 139, 143, 152, 159, 164, 165, 170, 268, 280

Andersson, U. and Pedersen, T. (2010). Organizational design mechanisms for the R&D function in a world of offshoring, *Scandinavian Journal of Management* **26**(4): pp. 431–438. 150

Angeli, F. and Grimaldi, R. (2010). Leveraging offshoring: The identification of new business opportunities in international settings, *Industry & Innovation* **17**(4): pp. 393–413. 144

Apple (2006). Google CEO Dr. Eric Schmidt joins Apple's board of directors. **URL:** *http://www.apple.com/pr/library/2006/08/29Google-CEO-Dr-Eric-Schmidt-Joins-Apples-Board-of-Directors.html* 1

Apple (2007). Apple reinvents the phone with iPhone. **URL:** *http://www.apple.com/pr/library/2007/01/09Apple-Reinvents-the-Phone-with-iPhone.html* 2

Apple (2009). Dr. Eric Schmidt resigns from Apple's board of directors. **URL:** *http://www.apple.com/pr/library/2009/08/03Dr-Eric-Schmidt-Resigns-from-Apples-Board-of-Directors.html* 2

Azadegan, A. and Dooley, K. J. (2010). Supplier innovativeness, organizational learning styles and manufacturer performance: An empirical assessment, *Journal of Operations Management* **28**(6): pp. 488–505. 62, 64, 149, 270

Badir, Y., Buchel, B. and Tucci, C. (2005). The role of the network lead company in integrating the NPD process across strategic partners, *International Journal of Entrepreneurship & Innovation Management* **5**(1/2): pp. 117–137. 54

Baldwin, C. and Clark, K. (1997). Managing in an age of modularity, *Harvard Business Review* **75**(5): pp. 84–94. 151, 258

Baloh, P., Jha, S. and Awazu, Y. (2008). Building strategic partnerships for managing innovation outsourcing, *Strategic Outsourcing: An International Journal* **1**(2): pp. 100–121. 32, 33, 35, 58, 145, 146, 183, 257

Barczak, G., Hultink, E. and Sultan, F. (2008). Antecedents and consequences of information technology usage in NPD: A comparison of Dutch and U.S. companies, *Journal of Product Innovation Management* **25**(6): pp. 620–631. 152, 165, 259

Bardhan, A. (2006). Managing globalization of R&D: Organizing for offshoring innovation, *Human Systems Management* **25**(2): pp. 103–114. 50, 59

Bardhan, A. and Kroll, C. (2006). Competitiveness and an emerging sector: The Russian software industry and its global linkages, *Industry & Innovation* **13**(1): pp. 69–95. 45

Barney, J. (1991). Firm resources and sustained competitive advantage, *Journal of Management* **17**(1): pp. 99–120. 37

Barney, J. (1999). How a firm's capabilities affect boundary decisions, *Sloan Management Review* **40**(3): pp. 137–145. 238, 275

Baumann, O. and Grupp, H. (2008). Firm boundary decisions: The market for health-related R&D services with an empirical case study for Germany, *International Economics & Economic Policy* **5**(3): pp. 297–321. 5, 141, 162

Bengtsson, L. and Berggren, C. (2008). The integrator's new advantage - the reassessment of outsourcing and production competence in a global telecom firm, *European Management Journal* **26**(5): pp. 314–324. 135

Bengtsson, L., von Haartman, R. and Dabhilkar, M. (2009). Low-cost versus innovation: Contrasting outsourcing and integration strategies in manufacturing, *Creativity & Innovation Management* **18**(1): pp. 35–47. 62, 64, 137, 170, 256, 270

Bhaskar, R. (1989). *Reclaiming Reality: A Critical Introduction to Contemporary Philosophy*, Verso, London, UK. 71

Birchall, D., Tovstiga, G. and Chanaron, J.-J. (2001). Capabilities in strategic knowledge sourcing and assimilation: A new look at innovation in the automotive industry, *International Journal of Automotive Technology and Management* **1**(1): pp. 78–91. 34, 125

Blanc, H. and Sierra, C. (1999). The internationalisation of R&D by multinationals: A trade-off between external and internal proximity, *Cambridge Journal of Economics* **23**: pp. 187–206. 163

Blind, K., Gauch, S. and Hawkins, R. (2010). How stakeholders view the impacts of international ICT standards, *Telecommunications Policy* **34**(3): pp. 162–174. 155

Bocquet, R. (2011). Product and process innovations in subcontracting: Empirical evidence from the French "Sillon Alpin", *Industry & Innovation* **18**(7): pp. 649–668. 61

Boehe, D. (2007). Product development in MNC subsidiaries: Local linkages and global interdependencies, *Journal of International Management* **13**(4): pp. 488–512. 59

Bout, B., Chang, V. and Lin, S. (2004). China's market for mobile phones, *McKinsey Quarterly* **31**(2): pp. 25–27. 54, 137

Brusoni, S. and Prencipe, A. (2001). Unpacking the black box of modularity: Technologies, products and organizations, *Industrial and Corporate Change* **10**(1): pp. 1247–1263. 133

Bryman, A. and Bell, E. (2011). *Business Research Methods*, Oxford University Press, Oxford, UK. 3, 71, 73, 75, 92, 93, 211

Buckley, P. and Casson, M. (2011). Marketing and the multinational: Extending internalisation theory, *Journal of the Academy of Marketing Science* **39**(4): pp. 492–508. 36, 135

Burns, T. and Stalker, G. (1961). *The Management of Innovation*, Tavistock, London, UK. 81

Busi, M. and McIvor, R. (2008). Setting the outsourcing research agenda: The top-10 most urgent outsourcing areas, *Strategic Outsourcing: An International Journal* **1**(3): pp. 185–197. 64

Calantone, R. and Stanko, M. (2007). Drivers of outsourced innovation: An exploratory study, *Journal of Product Innovation Management* **24**(3): pp. 230–241. 5, 34, 36, 45, 50, 56, 128, 129

Carson, S., Madhok, A., Varman, R. and John, G. (2003). Information processing moderators of the effectiveness of trust-based governance in interfirm R&D collaboration, *Organization Science* **14**(1): pp. 45–57. 35, 59, 156

Cass, S. (2007). Where the jobs are, *IEEE Spectrum* **44**(2): pp. 51–57. 35, 57, 123, 136, 137, 138, 256

Castellacci, F. (2010). The internationalization of firms in the service industries: Channels, determinants and sectoral patterns, *Technological Forecasting and Social Change* **77**(3): pp. 500–513. 142

Ceccagnoli, M., Graham, S., Higgins, M. and Lee, J. (2010). Productivity and the role of complementary assets in firms' demand for technology innovations, *Industrial & Corporate Change* **19**(3): pp. 839–869. 129

Cekola, J. (2007). Outsourcing drug investigations to India: A comment on U.S., Indian, and international regulation of clinical trials in cross-border pharmaceutical research, *Northwestern Journal of International Law & Business* **28**(1): pp. 125–145. 124, 127

Cesaroni, F. (2004). Technological outsourcing and product diversification: Do markets for technology affect firms' strategies?, *Research Policy* **33**(10): pp. 1547–1564. 54, 124

Chang, Y.-C., Chen, Y.-C. and Kuo, T.-K. (2009). Strategic technology sourcing in corporate ventures; a study of Taiwanese pharmaceutical firms, *International Journal of Entrepreneurial Behaviour & Research* **15**(5): pp. 497–517. 62, 64, 143, 145, 269, 270

Chatterji, D. (1996). Accessing external sources of technology, *Research Technology Management* **39**(2): pp. 48–57. 35, 145

Chauvin, L., Genest, D. and Loiseau, S. (2009). Ontological cognitive map, *International Journal on Artificial Intelligence Tools* **18**(5): pp. 697–716. 96

Checkland, P. (2006). *Learning for Action*, John Wiley & Sons Ltd., Chichester, UK. 98, 101, 189, 210

Chen, F.-Y. and Shen, T.-C. (2010). International original equipment manufacturing and original design manufacturing contracts with quality-differentiated products, *Pacific Economic Review* **15**(3): pp. 305–323. 140

Chen, L.-H. and Hung, C.-C. (2010). An integrated fuzzy approach for the selection of outsourcing manufacturing partners in pharmaceutical R&D, *International Journal of Production Research* **48**(24): pp. 7483–7506. 148, 258

Chen, S. (2005). Task partitioning in new product development teams: A knowledge and learning perspective, *Journal of Engineering & Technology Management* **22**(4): pp. 291–314. 45

Chen, Y. and Yuan, Y. (2007). The innovation strategy of firms: Empirical evidence from the Chinese high-tech industry, *Journal of Technology Management in China* **2**(2): pp. 145–153. 31, 33, 35, 45, 50, 127, 131, 135, 140

Chesbrough, H. and Crowther, A. (2006). Beyond high tech: Early adopters of open innovation in other industries, *R&D Management* **36**(3): pp. 229–236. 4, 34, 39, 51, 125, 131

Chesbrough, H. W. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, Boston, Massachusetts, USA. 4, 39, 130, 150

Chiesa, V., Manzinni, R. and Pizzurno, E. (2004). The externalisation of R&D activities and the growing market of product development services, *R&D Management* **34**(1): pp. 65–75. 31, 53, 159

Chiesa, V., Manzinni, R. and Tecilla, F. (2000). Selecting sourcing strategies for technological innovation: An empirical case study, *International Journal of Operations & Production Management* **20**(9): pp. 1017–1037. 60

Chou, Y.-C. and Yen, H.-Y. (2009). Business models for R&D service firms in Taiwan, *International Journal of Services Technology and Management* **11**(2): pp. 145–161. 59

Christensen, C. (2006). The ongoing process of building a theory of disruption, *Journal of Product Innovation Management* **23**: pp. 39–55. 10, 28, 78, 87, 169, 223, 284

Ciravegna, L. and Maielli, G. (2011). Outsourcing of new product development and the opening of innovation in mature industries: A longitudinal study of Fiat during crisis and recovery, *International Journal of Innovation Management* **15**(1): pp. 69–93. 4, 31, 32, 35, 62, 64, 67, 110, 111, 133, 162, 270, 277

Coase, R. (1937). The nature of the firm, *Economica* **4**: pp. 386–405. 36

Cohen, W. and Levinthal, D. (1990). Absorptive capacity: A new perspective on learning and innovation, *Administrative Science Quarterly* **35**(1): pp. 128–152. 37

Cole, G. and Kelly, P. (2011). *Management Theory and Practice*, Cengage Learning Inc., Andover, UK. 79

Colvin, M. and Maravelias, C. (2011). R&D pipeline management: Task interdependencies and risk management, *European Journal of Operational Research* **215**(3): pp. 616–628. 124

Conner, K. and Prahalad, C. (1996). A resource-based theory of the firm: Knowledge versus opportunism, *Organisational Science* **7**(5): pp. 477–501. 133

Cook, D. J., Greengold, N., Ellrodt, A. and Weingarten, S. (1997). The relation between systematic reviews and practice guidelines, *Annals of Internal Medicine* **126**(5): pp. 376–380. 20

Cooper, D. and Schindler, P. (2008). *Business Research Methods*, McGraw-Hill, London, UK. 100

Cooper, R., Edgett, S. and Kleinschmidt, E. (2001). *Portfolio Management for New Products*, Perseus Publishing, Cambridge, MA USA. 177, 236

Corbin, J. and Strauss, A. (2008). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, Sage Publications Ltd., London, UK. 85

Corley, K. and Gioia, D. (2011). Building theory about theory building: What constitutes a theoretical contribution?, *Academy of Management Review* **36**(1): pp. 12–32. 78

Cosner, R. (2009). Industrial research institute's R&D trends forecast for 2009, *Research Technology Management* **52**(1): pp. 19–26. 123

Cui, Z. and Loch, C. (2011). A strategic decision framework for innovation outsourcing, *International Journal of Innovation Management* **15**(5): pp. 899–930. 253, 254, 270

Cui, Z., Loch, C., Grossmann, B. and He, R. (2009). Outsourcing innovation, *Research Technology Management* **52**(6): pp. 54–63. 58, 148, 159, 258, 261, 279

Cusmano, L., Mancusi, M. and Morrison, A. (2009). Innovation and the geographical and organisational dimensions of outsourcing: Evidence from Italian firm-level data, *Structural Change & Economic Dynamics* **20**(3): pp. 183–195. 162

Cusmano, L., Mancusi, M. and Morrison, A. (2010). Globalization of production and innovation: How outsourcing is reshaping an advanced manufacturing area, *Regional Studies* **44**(3): pp. 235–252. 36, 127

Dahlander, L. and Gann, D. (2010). How open is innovation?, *Research Policy* **39**(6): pp. 699–709. 130, 131

Dain, M.-A. L., Calvi, R. and Cheriti, S. (2011). Measuring supplier performance in collaborative design: Proposition of a framework, *R&D Management* **41**(1): pp. 61–79. 164

Dankbaar, B. (2007). Global sourcing and innovation: The consequences of losing both organizational and geographical proximity, *European Planning Studies* **15**(2): pp. 271–288. 36, 45, 52, 56, 135, 163

de Braganca Pereira, C. and Barlow, R. (1990). Medical diagnosis: Using influence diagrams, *Networks: An International Journal* **20**(5): pp. 565–578. 97

de Vaus, D. (2001). *Surveys in Social Research*, Routledge, London, UK. 76

Deeds, D. and Rothaermel, F. (2003). Honeymoons and liabilities: The relationship between age and performance in research and development alliances., *Journal of Product Innovation Management* **20**(6): pp. 468–484. 149

Demirbag, M. and Glaister, K. (2010). Factors determining offshore location choice for R&D projects: A comparative study of developed and emerging regions, *Journal of Management Studies* **47**(8): pp. 1534–1560. 139, 142, 143

Denscombe, M. (2007). *The Good Research Guide*, Open University Press, Buckingham, UK. 90, 288

Department for Innovation, Universities & Skills (2008). *Persistence and Change in UK Innovation 2002-2006*, Department for Innovation, Universities & Skills, London, UK. 5

Dibbern, J. (2008). Explaining variations in client extra costs between software projects offshored to India, *MIS Quarterly* **32**(2): pp. 333–366. 143

Dibbern, J., Goles, T., Hirschheim, R. and Jayatilaka, B. (2004). Information systems outsourcing: A survey and analysis of the literature, *The DATA BASE for Advances in Information Systems* **35**(4): pp. 6–101. 22

Doran, G. (1981). There's a S.M.A.R.T. way to write management's goals and objectives, *Management Review* **70**(11): pp. 35–36. 181

Drayson, P. (2008). *Annual Innovation Report 2008*, Department for Innovation, Universities & Skills, London, UK. 5

Drever, E. (2003). *Using Semi-Structured Interviews in Small-Scale Research*, The SCRE Centre, University of Glasgow, Glasgow, UK. 203

Drew, S. (1995). Accelerating innovation in financial services, *Long Range Planning* **169**(4): pp. 29–33. 132

Easterby-Smith, M., Thorpe, R. and Jackson, P. (2008). *Management Research: Theory and Practice*, Sage Publications Ltd., London, UK. 101, 210

Easterby-Smith, M., Thorpe, R. and Lowe, A. (2002). *Management Research: An Introduction*, Sage Publications Ltd., London, UK. 101, 206

Eden, C. (1988). Cognitive mapping: A review, *European Journal of Operational Research* **36**: pp. 1–13. 96

Eden, C. (1992). On the status of cognitive maps, *Journal of Management Studies* **29**(3): pp. 261–265. 97

Eden, C. and Ackermann, F. (2000). Mapping distinctive competencies: A systemic approach, *Journal of the Operational Research Society* **51**: pp. 12–20. 96

Eden, C., Jones, S. and Sims, D. (1983). *Messing about in Problems*, Pergamon Press, Oxford, UK. 96, 97

Eisenhardt, K. (1989). Building theories from case study research, *Academy of Management Review* **14**(4): pp. 532–550. 53, 54, 73

Elango, B. (2008). Using outsourcing for strategic competitiveness in small and medium-sized firms, *Competitiveness Review* **18**(4): pp. 322–332. 133

Er, F. and Lezki, S. (2012). The usage of influence diagram for decision making in textiles, *Asian Social Science* **8**(11): pp. 163–169. 97, 98

Ernst, D. (2006). The offshoring of innovation, *Far Eastern Economic Review* **169**(4): pp. 29–33. 34, 123

Farris, G. and Cordero, R. (2002). Leading your scientists and engineers 2002, *Research Technology Management* **45**(6): pp. 13–26. 159

Fayol, H. (1949). *General and Industrial Management (translated by C. Storrs)*, Sir Isaac Pitman & Sons,, London, UK. 79

Fenton, A. (2006). Weft QDA user's manual.
URL: *http://www.pressure.to/qda/doc/* 94

Festel, G., Cleyn, S. D., Boutellier, R. and Braet, J. (2011). Optimizing the R&D process using spin-outs: Case studies from the pharmaceutical industry, *Research Technology Management* **54**(1): pp. 32–41. 34, 35, 57, 133, 138, 145, 164, 256

Fifarek, B. and Veloso, F. (2010). Offshoring and the global geography of innovation, *Journal of Economic Geography* **10**(4): pp. 559–578. 151

Fitzpatrick, W. and DiLullo, S. (2005). Strategic alliances and the management of intellectual properties: The art of the contract, *SAM Advanced Management Journal* **70**(3): pp. 38–45. 59, 154, 259

Flipse, S., van der Sanden, M., van der Velden, T., Fortuin, F., Omta, S. and Osseweijer, P. (2013). Identifying key performance indicators in food technology contract R&D, *Journal of Engineering and Technology Management* **30**(1): pp. 72–94. 261, 279

Ford, S., Mortara, L. and Probert, D. (2012). Disentangling the complexity of early-stage technology acquisitions, *Research Technology Management* **55**(3): pp. 40–48. 31, 258, 262

Frenken, K. (2006). A fitness landscape approach to technological complexity, modularity, and vertical disintegration, *Structural Change & Economic Dynamics* **17**(3): pp. 288–305. 45

Ganotakis, P. and Love, J. (2012). The innovation value chain in new technology-based firms: Evidence from the U.K., *Journal of Product Innovation Management* **29**(5): pp. 839–860. 5

Gantman, S. (2011). IT outsourcing in the public sector: A literature analysis, *Journal of Global Information Technology Management* **14**(2): pp. 48–83. 22

Garca-Vega, M. and Huergo, E. (2011). Determinants of international R&D outsourcing: The role of trade, *Review of Development Economics* **15**(1): pp. 93–107. 32, 127

Gawker (2010). How Google's Eric Schmidt lost his mistress, his partner and Steve Jobs.
URL: *http://gawker.com/5497193/exclusive-how-googles-eric-schmidt-lost-his-mistress-his-partner-and-steve-job* 2

Gersbach, H. and Schmutzler, A. (2011). Foreign direct investment and R&D-offshoring, *Oxford Economic Papers* **63**(1): pp. 134–157. 123

Gervais, D. (2009). (re)implementing the agreement on trade-related aspects of intellectual property rights to foster innovation, *Journal of World Intellectual Property* **12**(5): pp. 348–370. 140, 154

Giao, P., de Miranda Oliveira Junior, M. and de Vasconcellos, E. (2008). Services offshoring and its strategic effects on value chains, *Brazilian Administration Review* **5**(3): pp. 193–209. 34, 132, 179

Gioia, D. and Pitre, E. (1990). Multiparadigm perspectives on theory building., *Academy of Management Review* **15**: pp. 584–602. 78

Glaser, B. and Strauss, A. (1967). *The Discovery of Grounded Theory: Strategies for qualitative research*, Aldine Publishing Company, Chicago, IL USA. 85, 224

Glass, A. (2004). Outsourcing under imperfect protection of intellectual property, *Review of International Economics* **12**(5): pp. 867–884. 124, 127

Glimstedt, H., Bratt, D. and Karlsson, M. (2010). The decision to make or buy a critical technology: Semiconductors at Ericsson, 1980-2010, *Industrial & Corporate Change* **19**(2): pp. 431–464. 139, 150

Gobble, M. (2010). European telecoms embrace collaborative innovation, *Research Technology Management* **53**(4): pp. 2–3. 123, 126

Gonzalez, R., Gasco, J. and Llopis, J. (2006). Information systems outsourcing: A literature analysis, *Information & Management* **43**(7): pp. 821–834. 22

Goodwin, P. and Wright, G. (2009). *Decision Analysis for Management Judgment*, John Wiley & Sons Ltd., Chichester, UK. 97

Gooroochurn, N. and Hanley, A. (2007). A tale of two literatures: Transaction costs and property rights in innovation outsourcing, *Research Policy* **36**(10): pp. 1483–1495. 31, 127

Greenwood, R. and Hinings, C. (1993). Understanding strategic change: The contribution of archetypes, *Academy of Management Journal* **36**(5): pp. 1052–1081. 122

Grimaldi, R., Mattarelli, E., Prencipe, A. and von Zedtwitz, M. (2010). Offshoring of intangibles: Organizational and strategic issues, *Industry & Innovation* **17**(4): pp. 331–336. 257

Grimpe, C. and Kaiser, U. (2010). Balancing internal and external knowledge acquisition: The gains and pains from R&D outsourcing, *Journal of Management Studies* **47**(8): pp. 1483–1509. 31, 32, 33, 34, 136

Grote, M. and Taube, F. (2007). When outsourcing is not an option: International relocation of investment bank research - or isn't it, *Journal of International Management* **13**(1): pp. 57–77. 45, 49, 52, 57, 60, 150, 163, 182, 258

Gwynne, P. (2002). National lab seeks biomed collaborators, *Research Technology Management* **45**(2): pp. 4–7. 126, 141

Hamel, G. and Prahalad, C. (1994). *Competing for the Future*, Harvard Business School Press, Cambridge, Mass., USA. 179

Harrigan, K. (1985). Vertical integration and corporate strategy, *Academy of Management Journal* **28**(2): pp. 397–425. 128

Hatonen, J. (2010). Outsourcing and licensing strategies in small software firms: Evolution of strategies and implications for firm growth, internationalisation and innovation, *Technology Analysis & Strategic Management* **22**(5): pp. 609–630. 128

Hayashi, A. (2008). The make-or-buy question in mature industries, *MIT Sloan Management Review* **49**(3): pp. 4–6. 151, 258

Helfat, C. (2007). Dynamic capabilities: Foundations, *in* C. Helfat, S. Finkelstein, W. Mitchell, M. Peteraf, H. Singh, D. Teece and S. Winter (eds), *Dynamic capabilities: Understanding strategic change in organizations*, Blackwell Publishing, Malden, MA USA, pp. 1–18. 239

Hempell, T. and Zwick, T. (2008). New technology, work organisation, and innovation, *Economics of Innovation & New Technology* **17**(4): pp. 331–354. 152, 259, 278

Higgins, M. and Rodriguez, D. (2006). The outsourcing of R&D through acquisitions in the pharmaceutical industry, *Journal of Financial Economics* **80**(2): pp. 351–383. 34, 49, 54, 61, 129, 148

Hill, C. and Jones, G. (2001). *Strategic Management: An Integrated Approach*, Houghton Mifflin Company, Boston, MA. 4, 35

Ho, S. (2009). Information leakage in innovation outsourcing, *R&D Management* **39**(5): pp. 431–443. 157

Hoecht, A. and Trott, P. (2006). Innovation risks of strategic outsourcing, *Technovation* **26**(5/6): pp. 672–681. 51, 61, 155, 163

Holden, P. and Konishi, F. (2000). Technology transfer practice in Japanese corporations, *International Journal of Services Technology and Management* **1**(2/3): pp. 209–223. 159

Howard, M. and Squire, B. (2007). Modularization and the impact on supply relationships, *International Journal of Operations & Production Management* **27**(11): pp. 1192–1212. 156, 259

Howard, R. (1989). Knowledge maps, *Management Science* **35**(8): pp. 903–923. 96

Howard, R. and Matheson, J. (2005). Influence diagrams, *Decision Analysis* **2**(3): pp. 127–143. 96, 97

Howells, J., Gagliardi, D. and Malik, K. (2008). The growth and management of R&D outsourcing: Evidence from UK pharmaceuticals, *R&D Management* **38**(2): pp. 205–219. 35, 57, 67, 124, 136, 137, 138, 170, 256, 268

Howells, J., Gagliardi, D. and Malik, K. (2012). Sourcing knowledge: R&D outsourcing in UK pharmaceuticals, *International Journal of Technology Management* **59**(1/2): pp. 139–161. 61

Howells, J., James, A. and Malik, K. (2003). The sourcing of technological knowledge: Distributed innovation processes and dynamic change, *R&D Management* **33**(4): pp. 395–410. 131

Hsuan, J. and Mahnke, V. (2011). Outsourcing R&D: A review, model, and research agenda, *R&D Management* **41**(1): pp. 1–7. 31, 32, 110, 252, 269, 280

Hunt, D. and Williams, M. (2003). Taking stock of equity analysts, *The McKinsey Quarterly* **30**(3): pp. 141–143. 51

Huston, L. and Sakkab, N. (2007). Implementing open innovation, *Research Technology Management* **63**(8): pp. 21–25. 60, 157

Isaacson, W. (2011). *Steve Jobs*, Little, Brown, London, UK. 2

Jelinek, M. and Bean, A. (2010). New innovation architectures will shape R&D 'lab' of the future, *Research Technology Management* **53**(2): pp. 2–4. 126

Jiang, B. and Qureshi, A. (2006). Research on outsourcing results: Curent literature and future opportunities, *Management Decision* **44**(1): pp. 44–55. 22

Jones, J., Bowonder, B. and Wood, D. (2003). Critical competencies in virtual service webs, *European Management Journal* **21**(1): pp. 48–62. 159

Kahn, R. and Cannell, C. (1957). *The Dynamics of Interviewing*, Wiley, New York, NY USA. 100

Kelly, G. (1955). *The Psychology of Personal Coinstructs*, Norton, New York, USA. 97

Kervin, J. (1999). *Methods for Business Research*, Harper Collins, New York, NY USA. 91

Khan, S., Niazi, M. and Ahmad, R. (2011a). Barriers in the selection of offshore software development outsourcing vendors: An exploratory study using a systematic literature review, *Information & Software Technology* **53**(7): pp. 693–706. 21, 22

Khan, S., Niazi, M. and Ahmad, R. (2011b). Factors influencing clients in the selection of offshore software outsourcing vendors: An exploratory study using a systematic literature review, *Journal of Systems & Software* **84**(4): pp. 686–699. 22

King, D. (2006). Implications of uncertainty on firm outsourcing decisions, *Human Systems Management* **25**(2): pp. 115–125. 34, 53, 125

King, N. (2004). Using templates in the thematic analysis of text, *in* C. Cassell and G. Symon (eds), *Essential Guide to Qualitative Methods in Organizational Research*, Sage Publications Ltd., London, UK. 86, 88

King, N. (2012). Template analysis.
URL: *http://www2.hud.ac.uk/hhs/research/template_analysis/* 88, 96

Kleyn, D., Kitney, R. and Atun, R. (2007). Partnership and innovation in the life sciences, *International Journal of Innovation Management* **11**(2): pp. 323–347. 45, 46, 123, 155, 158, 260, 279

Kloyer, M. and Scholderer, J. (2012). Effective incomplete contracts and milestones in market-distant R&D collaboration, *Research Policy* **41**(2): pp. 346–357. 258

Kotabe, M., Mol, M. and Murray, J. (2008). Outsourcing, performance, and the role of e-commerce: A dynamic perspective, *Industrial Marketing Management* **37**(1): pp. 37–45. 34, 136

Kumar, S. and Snavely, T. (2004). Outsourcing and strategic alliances for product development: A case of Banta Digital Group, *Technovation* **24**(12): pp. 1001–1010. 164

Kvale, S. and Brinkmann, S. (2009). *InterViews: Learning the Craft of Qualitative Research Interviewing*, Sage Publications Inc., Thousand Oaks CA, USA. 12, 84, 203, 205, 207, 208, 222, 223, 227

Lacetera, N. (2009). Different missions and commitment power in R&D organizations: Theory and evidence on industry-university alliances, *Organization Science* **20**(3): pp. 565–582. 137

Lacity, M., Khan, S., Yan, A. and Willcocks, L. (2010). IT outsourcing in the public sector: A literature analysis, *Journal of Information Technology* **25**(4): pp. 395–433. 22

Lai, E., Riezman, R. and Wang, P. (2009). Outsourcing of innovation, *Economic Theory* **38**(3): pp. 485–515. 154

Lancaster, K. (1971). *Consumer Demand: A New Approach*, Columbia University Press, New York, USA. 171, 180, 268

Lawrence, P. and Lorsch, J. (1967). Differentiation and integration in complex organizations, *Administrative Science Quarterly* **12**(1): pp. 1–47. 81

Leiponen, A. (2005). Core complementarities of the corporation: Organization of an innovating firm, *Managerial and Decision Economics* **26**(6): pp. 351–365. 55, 61

Lepkowski, W. (2007). Engineers, academics, policymakers argue offshoring pros and cons, *Research Technology Management* **50**(3): pp. 2–4. 126

Levi, A. and Tetlock, P. (1980). A cognitive analysis of Japans 1941 decision for war, *Journal of Conflict Resolution* **24**(2): pp. 195–211. 96

Lewin, A., Massini, S. and Peeters, C. (2009). Why are companies offshoring innovation? the emerging global race for talent, *Journal of International Business Studies* **40**(6): pp. 901–926. 31, 34, 109, 126, 142

Li, Y., Liu, Y., Li, M. and Wu, H. (2008). Transformational offshore outsourcing: Empirical evidence from alliances in China, *Journal of Operations Management* **26**(2): pp. 257–274. 5, 35, 155, 259

Lim, W. and Tan, S.-J. (2009). Using brand equity to counter outsourcing opportunism: A game theoretic approach, *Marketing Letters* **20**(4): pp. 369–383. 157

Lincoln, Y. and Guba, E. (1985). *Naturalistic Inquiry*, Sage Publications Inc., Beverley Hills, California USA. 10, 19, 75, 284

Lofland, J., Snow, D., Anderson, L. and Lofland, L. (2004). *Analyzing Social Settings: A Guide to Qualitative Observation and Analysis*, Wadsworth Publishing Company Inc. 92

Lofstrom, S. (2000). Absorptive capacity in strategic alliances: Investigating the effects of individuals' social and human capital on inter-firm learning, *Organization Science Winter Conference*, Keystone, CO USA. 149

Love, J. and Roper, S. (2001). Outsourcing in the innovation process: Locational and strategic determinants, *Papers in Regional Science* **80**(3): pp. 317–337. 31, 32, 33, 34, 35, 114, 131

Lowman, M., Trott, P., Hoecht, A. and Sellam, Z. (2012). Innovation risks of outsourcing in pharmaceutical new product development, *Technovation* **32**(2): pp. 99–109. 61, 262

Lucena, A. (2011). The organizational designs of R&D activities and their performance implications: Empirical evidence for Spain, *Industry & Innovation* **18**(2): pp. 151–176. 31, 146

Macher, J., Mowery, D. and Minin, A. D. (2007). The non-globalization of innovation in the semiconductor industry, *California Management Review* **50**(1): pp. 217–242. 124, 140

Macpherson, A. (2008). Producer service linkages and industrial innovation: Results of a twelve-year tracking study of New York State manufacturers, *Growth and Change* **39**(1): pp. 1–23. 123, 126, 141

Manning, S., Massini, S. and Lewin, A. (2008). A dynamic perspective on next-generation offshoring: The global sourcing of science and engineering talent, *The Academy of Management* **22**(3): pp. 35–54. 126

March, J. (1991). Exploration and exploitation in organizational learning, *Organization Science* **2**(1): pp. 71–88. 37

Martinez-Noya, A. and Garcia-Canal, E. (2011). Technological capabilities and the decision to outsource/outsource offshore R&D services, *International Business Review* **20**: pp. 264–277. 32

Martinez-Noya, A., Garcia-Canal, E. and Guillen, M. (2012). International R&D service outsourcing by technology-intensive firms: Whether and where?, *Journal of International Management* **18**(1): pp. 18–37. 257

Martinez-Noya, A., Garcia-Canal, E. and Guillen, M. (2013). R&D outsourcing and the effectiveness of intangible investments: Is proprietary core knowledge walking out of the door?, *The Journal of Management Studies* **50**(1): pp. 67–91. 261, 279

Maskell, P., Pedersen, T., Petersen, B. and Dick-Nielsen, J. (2007). Learning paths to offshore outsourcing: From cost reduction to knowledge seeking, *Industry & Innovation* **14**(3): pp. 239–257. 46

Massini, S. and Miozzo, M. (2012). Outsourcing and offshoring of business services: Challenges to theory, management and geography of innovation, *Regional Studies* **46**(9): pp. 1219–1242. 259, 278

Massini, S., Perm-Ajchariyawong, N. and Lewin, A. (2010). Role of corporate-wide offshoring strategy on offshoring drivers, risks and performance, *Industry & Innovation* **17**(4): pp. 337–371. 115, 137, 143, 145

Mattarelli, E. and Tagliaventi, M. (2010). Work-related identities, virtual work acceptance and the development of glocalized work practices in globally distributed teams, *Industry and Innovation* **17**(4): pp. 415–443. 144, 163

McDermott, C. and Coates, T. (2007). Managing competencies in breakthrough product development: A comparative study of two material processing projects, *IEEE Transactions on Engineering Management* **54**(2): pp. 340–350. 135

McIvor, R. (2005). *The Outsourcing Process: Strategies for Evaluation and Management*, Cambridge University Press, Cambridge, UK. 5, 32, 33, 178, 268

Medina, C., Lavado, A. and Cabrera, R. (2005). Characteristics of innovative companies: A case study of companies in different sectors, *Creativity & Innovation Management* **14**(3): pp. 272–287. 53, 138

Mehta, S. and Peters, L. (2007). Outsourcing a core competency, *Research Technology Management* **50**(3): pp. 28–34. 36, 53

Merton, R. (1967). *On Theoretical Sociology*, Free Press, New York, USA. 72

Meyer, C. and Ruggles, R. (2002). Search parties, *Harvard Business Review* **80**(8): pp. 14–15. 147

Mihalache, O., Jansen, J., van den Bosch, F. and Volberda, H. (2012). Offshoring and firm innovation: The moderating role of top management team attributes, *Strategic Management Journal* **33**(13): pp. 1480–1498. 280

Mikkola, J. (2003). Modularity, component outsourcing, and inter-firm learning, *R&D Management* **33**(4): pp. 439–454. 162

Miles, M. and Huberman, A. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*, Sage Publications Inc., Thousand Oaks CA, USA. 223

Milliken, F. (1987). Three types of perceived uncertainty about the environment: State, effect and response uncertainty, *Academy of Management Review* **12**: pp. 133–143. 124

Miozzo, M. and Grimshaw, D. (2005). Modularity and innovation in knowledge-intensive business services: IT outsourcing in Germany and the UK, *Research Policy* **34**(9): pp. 1419–1439. 45, 53, 159, 161

Mohiuddin, M. (2011). Research on offshore outsourcing: A systematic literature review, *Journal of International Business Research* **10**: pp. 59–76. 22

Mol, M. (2005). Does being R&D intensive still discourage outsourcing? evidence from Dutch manufacturing, *Research Policy* **34**(4): pp. 571–582. 54, 128

Mol, M., Pauwels, P., Matthyssens, P. and Quintens, L. (2004). A technological contingency perspective on the depth and scope of international outsourcing, *Journal of International Management* **10**(2): pp. 287–305. 124

Mol, M., van Tulder, R. and Beije, P. (2005). Antecedents and performance consequences of international outsourcing, *International Business Review* **14**(5): pp. 599–617. 54

Mortara, L., Slacik, I., Napp, J. and Minshall, T. (2010). Implementing open innovation: Cultural issues, *International Journal of Entrepreneurship and Innovation Management* **11**(4): pp. 369–397. 158, 165, 260, 279, 280

Motohashi, K. and Ziao, Y. (2007). China's innovation system reform and growing industry and science linkages, *Research Policy* **36**(8): pp. 1251–1260. 127, 141

Mudambi, S. and Tallman, S. (2010). Make, buy or ally? theoretical perspectives on knowledge process outsourcing through alliances, *Journal of Management Studies* **47**(8): pp. 1434–1456. 130, 132

Mukherjee, A. and Ray, A. (2007). Strategic outsourcing and R&D in a vertical structure, *Manchester School (14636786)* **75**(3): pp. 297–310. 46, 54

Munsch, K. (2004). Outsourcing design and innovation, *Research Technology Management* **47**(1): pp. 27–30. 60, 157, 260

Murray, J., Kotabe, M. and Westjohn, S. (2009). Global sourcing strategy and performance of knowledge-intensive business services: A two-stage strategic fit model, *Journal of International Marketing* **17**(4): pp. 90–105. 34, 142, 253, 254, 270

Nambisan, S. and Sawhney, M. (2007). A buyer's guide to the innovation bazaar, *Harvard Business Review* **85**(6): pp. 109–118. 35, 46, 51, 58, 135, 147, 180

Narula, R. (2004). R&D collaboration by SMEs: New opportunities and limitations in the face of globalisation, *Technovation* **24**(2): pp. 153–162. 54, 128

Niezen, C. and Weller, W. (2006). Procurement as strategy, *Harvard Business Review* **84**(9): pp. 22–24. 148

Noke, H. and Hughes, M. (2010). Climbing the value chain; strategies to create a new product development capability in mature SMEs, *International Journal of Operations & Production Management* **30**(2): pp. 132–154. 38, 141

Nonaka, I. and Takeuchi, H. (1995). *The Knowledge-creating Company*, Oxford University Press, Oxford, UK. 78

Oliveira, M., Hartung, K. and Wendling, M. (2010). Outsourcing and offshore: An analysis of the academic literature, *Portuguese Journal of Management Studies* **15**(2): pp. 215–234. 22

O'Regan, N. and Kling, G. (2011). Technology outsourcing in manufacturing small- and medium-sized firms: Another competitive resource?, *R&D Management* **41**(1): pp. 92–105. 31, 37, 128

Oxford Dictionaries (2011). *Concise Oxford English Dictionary: Main edition*, Oxford University Press, Oxford, UK. 78

Paoli, M. and Prencipe, A. (1999). The role of knowledge bases in complex product systems: Some empirical evidence from the aero engine industry, *Journal of Management & Governance* **3**(2): pp. 137–160. 55, 60, 151, 160, 261, 279

Penrose, E. (1959). *The Theory of the Growth of the Firm*, Basil Blackwell, Oxford, UK. 37

Perrons, R. and Platts, K. (2005a). Make-buy decisions in the face of technological change: Does industry clockspeed matter?, *International Journal of Management & Enterprise Development* **2**(1): pp. 1–11. 135

Perrons, R. and Platts, K. (2005b). Outsourcing strategies for radical innovations: Does industry clockspeed make a difference?, *Journal of Manufacturing Technology Management* **16**(8): pp. 842–863. 148

Piachaud, B. (2002). Outsourcing in the pharmaceutical manufacturing process: An examination of the CRO experience, *Technovation* **22**(2): pp. 81–90. 35, 57, 67, 136, 170, 235, 255, 268, 274

Plewa, C. and Quester, P. (2006). Satisfaction with university-industry relationships: The impact of commitment, trust and championship, *International Journal of Technology Transfer & Commercialisation* **5**(1/2): pp. 79–101. 35, 53, 59, 156, 164, 260

Porter, M. (1980). *Competitive Strategy*, Free Press, New York, USA. 269

Porter, M. (1986). Competition in global industries: A conceptual framework, *in* M. Porter (ed.), *Competition in Global Industries*, Harvard Business School, Cambridge, Harvard Business School, pp. 15–60. 37

Prahalad, C. and Hamel, G. (1990). The core competence of the corporation, *Harvard Business Review* **68**(4): pp. 79–91. 38, 270

Prahalad, C. and Hamel, G. (1994). *Competing for the Future*, Harvard Business School Press, Cambridge MA, USA. 38

Prencipe, A. (1997). Technological competencies and product's evolutionary dynamics a case study from the aero-engine industry, *Research Policy* **25**(8): pp. 1261–1277. 55

Quan, X. (2010). Knowledge diffusion from MNC R&D labs in developing countries: Evidence from interaction between MNC R&D labs and local universities in Beijing, *International Journal of Technology Management* **51**(2/3/4): pp. 364–386. 147

Quelin, B. and Duhamel, F. (2003). Bringing together strategic outsourcing and corporate strategy: Outsourcing motives and risks, *European Management Journal* **21**(5): pp. 647–661. 81

Quinn, J. (2000). Innovation: The new engine of growth, *MIT Sloan Management Review* **41**(4): pp. 13–28. 5, 33, 67, 113, 126, 131, 135, 137

Rao, P. (2008). The emergence of the pharmaceutical industry in the developing world and its implications for multinational enterprise strategies, *International Journal of Pharmaceutical and Healthcare Marketing* **2**(2): pp. 103–116. 127

Ravald, A. and Groonroos, C. (1996). The value concept and relationship marketing, *European Journal of Marketing* **30**(2): pp. 19–30. 171

Ritchie, J. and Spencer, L. (1994). Qualitative data analysis for applied policy research, *in* A.Bryman and R. Burgess (eds), *Analyzing Qualitative Data*, Routledge, Abingdon, UK, chapter 9, pp. 173–194. 86

Robson, C. (2002). *Real World Research: A Resource for Social Scientists and Practioner-Researchers*, Blackwell Publishing, Oxford, UK. 28, 56, 71, 73, 76, 100, 206

Robson, S. and Haigh, G. (2008). First findings from the UK innovation survey 2007, *Economic & Labour Market Review* **2**(4): pp. 47–53. 5

Rohrbeck, R., Dhler, M. and Arnold, H. (2009). Creating growth with externalization of R&D results-the spin-along approach, *Global Business & Organizational Excellence* **28**(4): pp. 44–51. 145

Rothaermel, F., Hitt, M. and Jobe, L. (2006). Balancing vertical integration and strategic outsourcing: Effects on product portfolio, product success, and firm performance, *Strategic Management Journal* **27**(11): pp. 1033–1056. 34, 45, 54, 60, 136, 157, 260, 279

Rothwell, R. (1992). Successful industrial innovation: Critical factors for the 1990s, *R&D Management* **22**(3): pp. 221–240. 38

Rothwell, R. and Dodgson, M. (1994). Innovation and size of firm, *in* M. Dodgson (ed.), *Handbook of Industrial Innovation*, Edward Elgar, Aldershot, UK, pp. pp. 310–324. 128

Roy, S. and Sivakumar, K. (2011). Managing intellectual property in global outsourcing for innovation generation, *Journal of Product Innovation Management* **28**(1): pp. 48–62. 62, 64, 79, 140, 154, 156, 259, 270

Roy, S. and Sivakumar, K. (2012). Global outsourcing relationships and innovation: A conceptual framework and research propositions, *Journal of Product Innovation Management* **29**(4): pp. 513–530. 259

Rundquist, J. (2008). World-class or good enough - the choice of partner when outsourcing new product development in medium-sized firms, *International Journal of Innovation & Technology Management* **5**(4): pp. 423–445. 143, 147, 148

Rundquist, J. and Halila, F. (2010). Outsourcing of NPD activities: A best practice approach, *European Journal of Innovation Management* **13**(1): pp. 5–23. 34, 128, 147, 148

Rutten, R. and Boekema, F. (2007). Spatial innovation systems: Theory and cases - an introduction, *European Planning Studies* **15**(2): pp. 171–177. 142

Santos, F., Abrunhosa, A. and Costa, I. (2006). How to compete in mature industries? boundary architecture as a mechanism for strategic renewal, *Strategic Management Society Annual International Conference*, Vienna, Austria. 151

Saunders, M., Lewis, P. and Thornhill, A. (2009). *Research Methods for Business Students*, Prentice Hall, Harlow, UK. 10, 56, 77, 89, 91, 101, 202, 206, 222, 223

Sen, A. and Haq, K. (2010). Internationalization of SMEs: Opportunities and limitations in the age of globalization, *International Business & Economics Research Journal* **9**(5): pp. 135–142. 34, 128

Sen, A. and Haq, K. (2011). Product innovation by small and medium-sized firms through outsourcing and collaboration, *International Journal of Management & Marketing Research* **4**(1): pp. 61–73. 32, 128

Sen, A. and MacPherson, A. (2009). Outsourcing, external collaboration, and innovation among U.S. firms in the biopharmaceutical industry, *Industrial Geographer* **6**(1): pp. 20–36. 57, 129, 133, 256

Sen, F. and Rubenstein, A. (1990). An exploration of factors affecting the integration of in-house R&D with external technology acquisition strategies of a firm, *IEEE Transactions on Engineering Management* **37**(4): pp. 246–259. 40

Sener, F. and Zhao, L. (2009). Globalization, R&D and the iPod cycle, *Journal of International Economics* **77**(1): pp. 101–108. 34, 113, 123, 127, 154

Smith, M., Busi, M., Ball, P. and van der Meer, R. (2008). Factors influencing an organisation's ability to manage innovation: A structured literature review and conceptual model, *International Journal of Innovation Management* **12**(4): pp. 655–676. 91, 157, 285

Staniuliene, S. (2009). Development of outsourcing in network structure design, *Management of Organizations: Systematic Research* **52**: pp. 97–113. 164

Stanko, M. and Calantone, R. (2011). Controversy in innovation outsourcing research: Review, synthesis and future directions., *R&D Management* **41**(1): pp. 8–20. 34, 113, 138

Stephan, M., Pfaffmann, E. and Sanchez, R. (2008). Modularity in cooperative product development: The case of the MCC 'smart' car, *International Journal of Technology Management* **42**(4): pp. 439–458. 151, 258

Stewart, D. and Kamins, M. (1993). *Secondary Research: Information Sources and Methods*, Sage Publications Ltd., Newbury Park, CA USA. 90

Storey, J., Quintas, P., Taylor, P. and Fowle, W. (2002). Flexible employment contracts and their implications for product and process innovation, *International Journal of Human Resource Management* **13**(1): pp. 1–18. 45, 53

Storper, M. and Venables, A. (2004). Buzz: Face-to-face contact and the urban economy, *Journal of Economic Geography* **4**(4): pp. 351–370. 163

Strauss, A. and Corbin, J. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, Sage Publications, USA. 85

Takeishi, A. (2002). Knowledge partitioning in the interfirm division of labor: The case of automotive product development, *Organization Science* **13**(3): pp. 321–338. 59, 151

Tashakkori, A. and Teddlie, C. (2003). *Handbook of Mixed Methods in Social and Behavioural Research*, Sage, Thousand oaks, CA USA. 81

Taylor, F. (1911). *The Principles of Scientific Management*, Harper & Brothers, New York, NY USA. 79

Teece, D. (1986). Profiting from technological innovation, *Research Policy* **15**(6): pp. 285–305. 128

Teece, D., Pisano, G. and Shuen, A. (1997). Dynamic capabilities and strategic management, *Strategic Management Journal* **18**(7): pp. 509–533. 38, 178, 239, 256

Teirlinck, P., Dumont, M. and Spithoveny, A. (2010). Corporate decision-making in R&D outsourcing and the impact on internal R&D employment intensity, *Industrial and Corporate Change* **19**(6): pp. 1741–1768. 60, 153, 259

Tidd, J., Bessant, J. and Pavitt, K. (2005). *Managing innovation: Integrating technological, market and organizational change*, John Wiley & Sons Ltd., Chichester, U.K. 4, 32

Tiwana, A. (2008). Does interfirm modularity complement ignorance? a field study of software outsourcing alliances, *Strategic Management Journal* **29**(11): pp. 1241–1252. 165

Tiwana, A. and Keil, M. (2007). Does peripheral knowledge complement control? an empirical test in technology outsourcing alliances, *Strategic Management Journal* **28**(6): pp. 623–634. 46, 50, 156, 260

Tranfield, D., Denyer, D. and Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review, *British Journal of Management* **14**(3): pp. 207–222. 20

Tsai, K.-H. and Wang, J.-C. (2009). External technology sourcing and innovation performance in LMT sectors: An analysis based on the Taiwanese technological innovation survey, *Research Policy* **38**(3): pp. 518–526. 153

Tucker, M. and John, F. (2012). Managing global outsourcing to enhance lean innovation, *Research Technology Management* **55**(5): pp. 44–50. 258

Ulset, S. (1996). R&D outsourcing and contractual governance: An empirical study of commercial R&D projects, *Journal of Economic Behavior & Organization* **30**(1): pp. 63–82. 40, 132

Upstill, G. and Hall, P. (2006). Innovation in the minerals industry: Australia in a global context, *Resources Policy* **31**(3): pp. 137–145. 45, 49, 55, 124

Wagner, S., Erhun, F. and Gross-Ruyken, P. (2009). Slashing supplier costs, *Industrial Engineer* **41**(2): pp. 31–31. 148

Wareham, J., Mathiassen, L., Rai, A., Straub, D. and Klein, R. (2005). The business value of digital supply networks: A program of research on the impacts of globalization, *Journal of International Management* **11**(2): pp. 201–227. 165

Weeks, M. (2009). Sourcing practices and innovation: Evidence from the auto industry on the sourcing relationship as a dynamic capability, *Innovation: Management, Policy & Practice* **11**(3): pp. 304–326. 164

Weeks, M. and Thomason, S. (2011). An exploratory assessment of the linkages between HRM practices, absorptive capacity and innovation in outsourcing relationships, *International Journal of Innovation Management* **15**(2): pp. 303–334. 37

Williamson, O. (1975). *Markets and Hierarchies*, Free Press, New York, USA. 36, 238

Williamson, O. (1985). *The economic institutions of capitalism: Firms, markets and relational contracting*, Free Press, New York, USA. 36, 238

Wind, Y. (2006). Blurring the lines: Is there a need to rethink industrial marketing?, *Journal of Business & Industrial Marketing* **21**(7): pp. 474–481. 130

Wolf, F., Shea, J. and Albanese, M. (2001). Toward setting a research agenda for systematic reviews of evidence of the effects of medical education, *Teaching and Learning in Medicine* **13**(1): pp. 54–60. 20

Wolff, M. (2006). Global innovation models changing, *Research Technology Management* **49**(4): pp. 5–7. 130

Wouters, M. (2010). Customer value propositions in the context of technology commercialization, *International Journal of Innovation Management* **14**(6): pp. 1099–1127. 153, 155, 259, 278

Wu, F., Li, H., Chu, L. and Sculli, D. (2013). Supplier selection for outsourcing from the perspective of protecting crucial product knowledge, *International Journal of Production Research* **51**(5): pp. 1508–1519. 258

Yifei, S., von Zedtwitz, M. and Simon, D. (2007). Globalization of R&D and China: An introduction, *Asia Pacific Business Review* **13**(3): pp. 311–319. 45, 50, 61

Yin, R. (2009). *Case Study Research: Design and Methods*, Sage Publications Ltd., London, UK. 73, 206, 223

Zadeh, L. (1965). Fuzzy sets, *Information and Control* **8**(3): pp. 338–353. 38

Zenger, T. and Lazzarini, S. (2004). Compensating for innovation: Do small firms offer high-powered incentives that lure talent and motivate effort?, *Managerial and Decision Economics* **25**(6/7): pp. 329–345. 45, 59, 159, 260

Zhao, Y. and Calantone, R. (2003). The trend toward outsourcing in new product development: Case studies in six firms, *International Journal of Innovation Management* **7**(1): pp. 51–67. 138

Zirpoli, F. and Becker, M. (2011a). The limits of design and engineering outsourcing: Performance integration and the unfulfilled promises of modularity, *R&D Management* **41**(1): pp. 21–43. 60, 62, 64, 67, 151, 162, 258, 262, 269, 270, 276

Zirpoli, F. and Becker, M. (2011b). What happens when you outsource too much?, *MIT Sloan Management Review* **52**(2): pp. 59–64. 62, 64, 67, 151, 161, 262, 270, 276

Znaniecki, F. (1934). *The Method of Sociology*, Farrar & Rinehart, New York, NY USA. 85

Zollo, M. and Winter, S. (2002). Deliberate learning and the evolution of dynamic capabilities, *Organization Science* **13**(53): pp. 339–351. 178, 256

Appendix A

Interview Survey Instrument

The innovation outsourcing interview survey instrument is displayed overleaf.

Cranfield UNIVERSITY

Outsourcing Innovation

A Management Capability Survey Instrument

CONTENTS

Introduction

1.1 - This document

This document is a survey instrument to help identify how firms outsource innovation and whether existing practices could be improved. It forms a key input to a study which aims to provide a holistic understanding of management capability for outsourcing innovation.

An extensive review of innovation outsourcing identifies a fragmented understanding of a complex inter-related discipline. This document presents an innovation outsourcing reference model against which existing management capability and potential areas of focus for improvement are identified in a discussion setting.

1.2 - What do we mean by innovation outsourcing

The outsourcing of innovation is a practice which is increasingly adopted by firms to improve performance. It concerns the antecedence, processes and implications by which a firm substitutes or complements its internal innovation activity with that sourced from outside its boundaries.

1.3 - Why is it important

Undertaken properly, innovation outsourcing has the potential to secure the long-term success of a firm through greater and more efficient innovative capability. If executed poorly, it has the potential to lead to a firm's demise through the loss of competencies. It is within this context that firms must develop a robust understanding and capability for outsourcing innovation.

1.4 - What is involved

An initial reference model has been developed from a survey of over 230 academic papers. The model represents a current understanding of management capability for outsourcing innovation. It forms the basis for comparison with real situations in order to identify areas of focus for management. A number of firms are to participate in the survey.

- We present a set of rich pictures that represent a reference model for outsourcing innovation.

- Key questions are used to prompt discussion about your firm's management practices for outsourcing innovation.

- We ask you to think about how your firm outsources innovation.
    - What does your firm do that is the same as that in the reference model?
    - What does your firm do that is different as that in the reference model?
    - Is there anything that your firm could do differently?

Responses to the survey will be collated and used to develop a conceptual model comprising available established good practice for outsourcing innovation.

Business Information

Name:	
Company:	
Position:	
Job description:	
Department:	
Address:	
Phone:	
Email:	

Innovation Outsourcing Reference Model

3.1 - Innovation Outsourcing Process Overview

Description:

Fig.1a is an overview of the process for outsourcing innovation by a firm. It represents the holistic process by which a firm selects and implements outsourced innovation activity in order to improve innovation performance.

The process involves determining:

- what innovation activity a firm should outsource and why?
- where a firm should outsource innovation activity and to whom?
- how the firm should outsource innovation activity and what organisational change it needs to effect in order to support its innovation outsourcing decisions?
- how the firm manages the outsourcing of innovation across its boundaries?

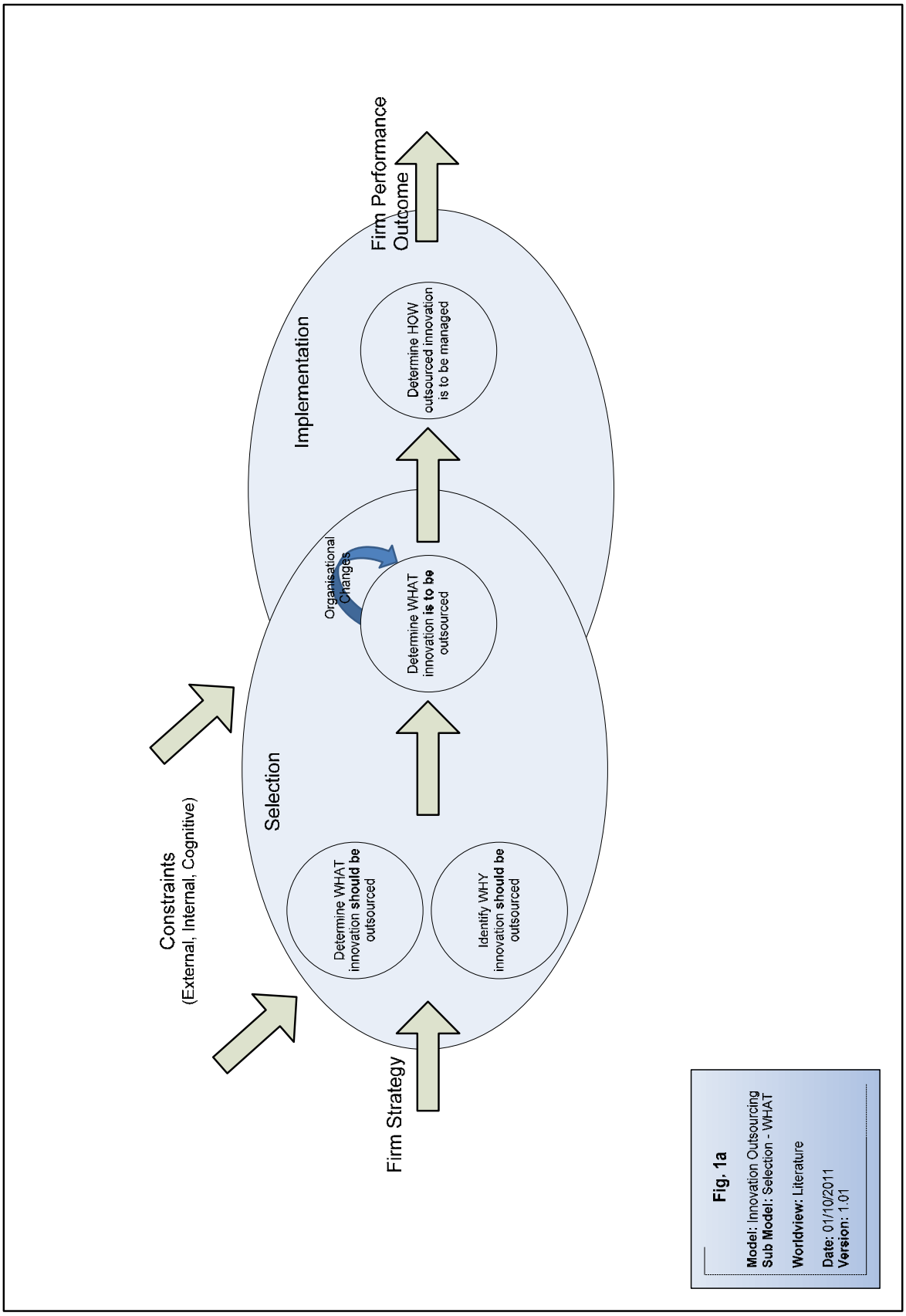
The firm's decisions and actions are bound by its environmental, (i.e., internal and external), and cognitive constraints. These are the set of perceptions that guide its actions.

Key Questions:

Please review Fig.1a and consider the overall approach that your firm uses to outsource innovation.

- Does your firm have an overall approach for outsourcing innovation?
- What approach does your firm take when outsourcing innovation?

Comments:


Firm Performance Outcome
Implementation
Determine HOW outsourced innovation is to be managed
Organisational Changes
Determine WHAT innovation **is to be** outsourced
Selection
Determine WHAT innovation **should be** outsourced
Identify WHY innovation **should be** outsourced
Constraints
(External, Internal, Cognitive)
Firm Strategy
Fig. 1a
Model: Innovation Outsourcing
Sub Model: Selection - WHAT
Worldview: Literature
Date: 01/10/2011
Version: 1.01

3.2 - Environmental Constraints

Description:

Figures 1b, 1c and 1d represent the environmental constraints that potentially bear on a firm's process to outsource innovation.

Fig. 1b represents the external constraints that bear on a firm's process to outsource innovation. These are the perceptions concerning the global environment which contribute to the firm's decisions and actions to outsource innovation.

Fig. 1c represents the internal constraints that bear on a firm's process to outsource innovation. These are the existing characteristics of the firm which have a bearing on its decisions and actions to outsource innovation.

Fig. 1d represents the cognitive constraints that bear on a firm's process to outsource innovation. These relate to the beliefs and ideas held by the firm and which potentially impact its decisions and actions to outsource innovation.

Key Questions:

Please review Figures 1b. 1c. and 1d, and consider what perceptions impact your firm's decisions for outsourcing innovation.

- What perceptions of the external environment have influenced your firm to outsource innovation?
- What perceptions of the firm's characteristics have influenced decisions to outsource innovation?
- What does senior management within your firm understand about what outsourcing innovation entails?

Comments:

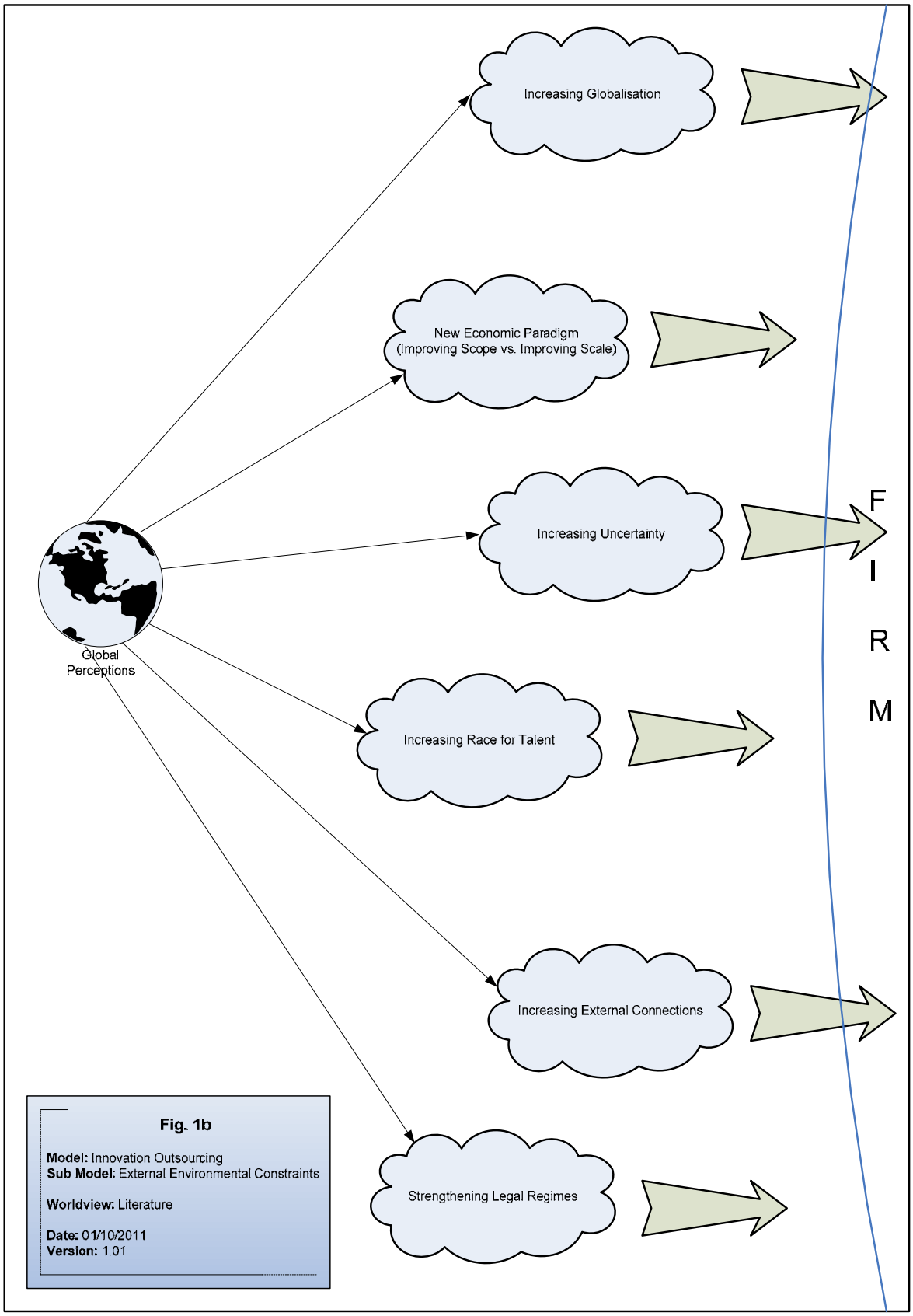


Fig. 1b

Model: Innovation Outsourcing
Sub Model: External Environmental Constraints

Worldview: Literature

Date: 01/10/2011
Version: 1.01

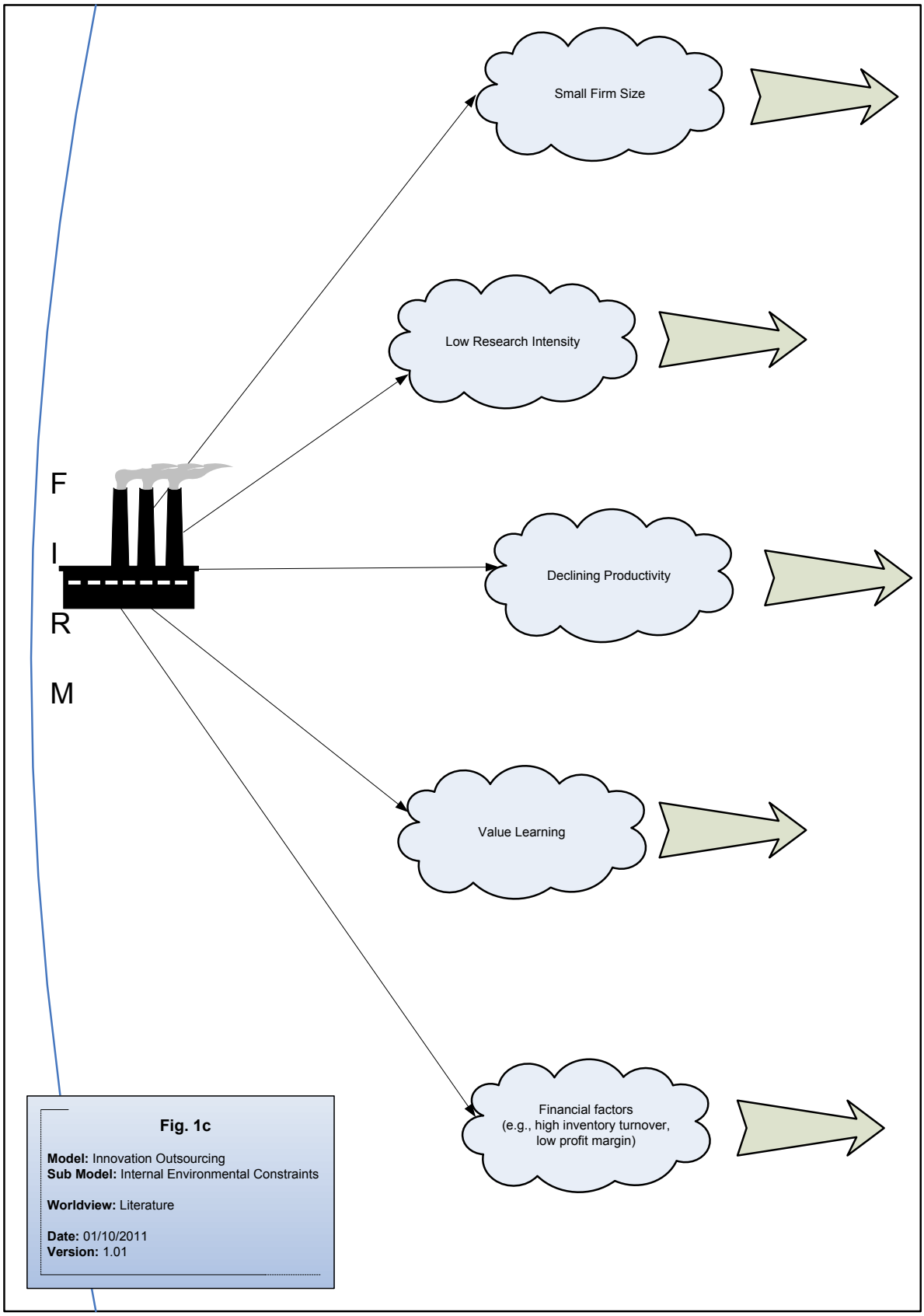


Fig. 1c

Model: Innovation Outsourcing
Sub Model: Internal Environmental Constraints

Worldview: Literature

Date: 01/10/2011
Version: 1.01

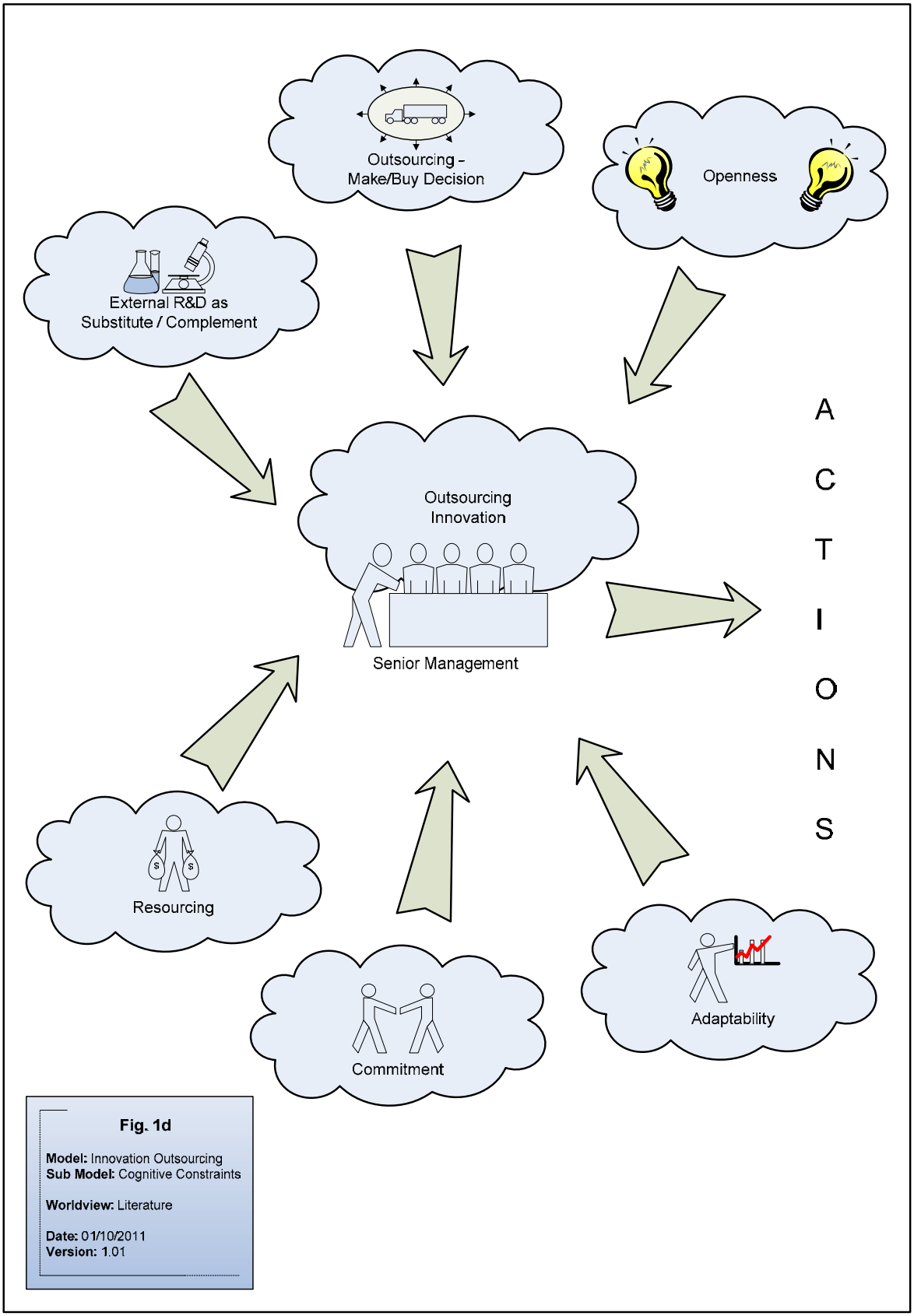


Fig. 1d

Model: Innovation Outsourcing
Sub Model: Cognitive Constraints

Worldview: Literature

Date: 01/10/2011
Version: 1.01

3.3 - Selection – WHAT *should be* Outsourced

Description:

Figures 2a and 2b represent the process by which a firm determines what it can potentially outsource to improve innovation performance and what it must not outsource in order to protect its competencies.

The process involves determining:

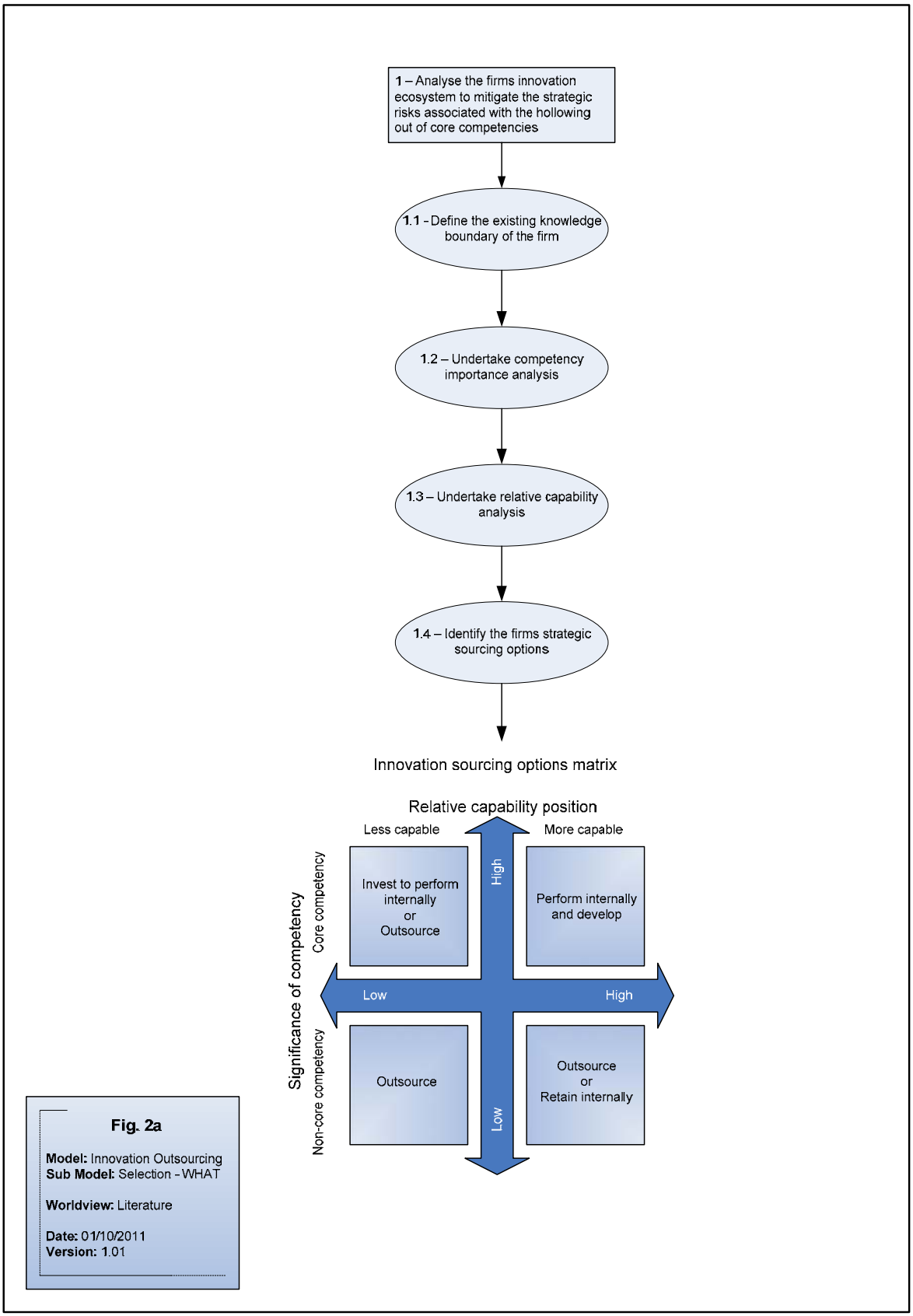
- The significance to the firm of its specific competencies and its capability in those competencies relative to other organisations.
- The scale and extent of industry/market factors and company factors to identify the stage, (i.e., from raw ideas to market-ready products), at which potential innovations should be outsourced.
- The scale and extent of innovation that is potentially outsourced to mitigate the risk of over-outsourcing.

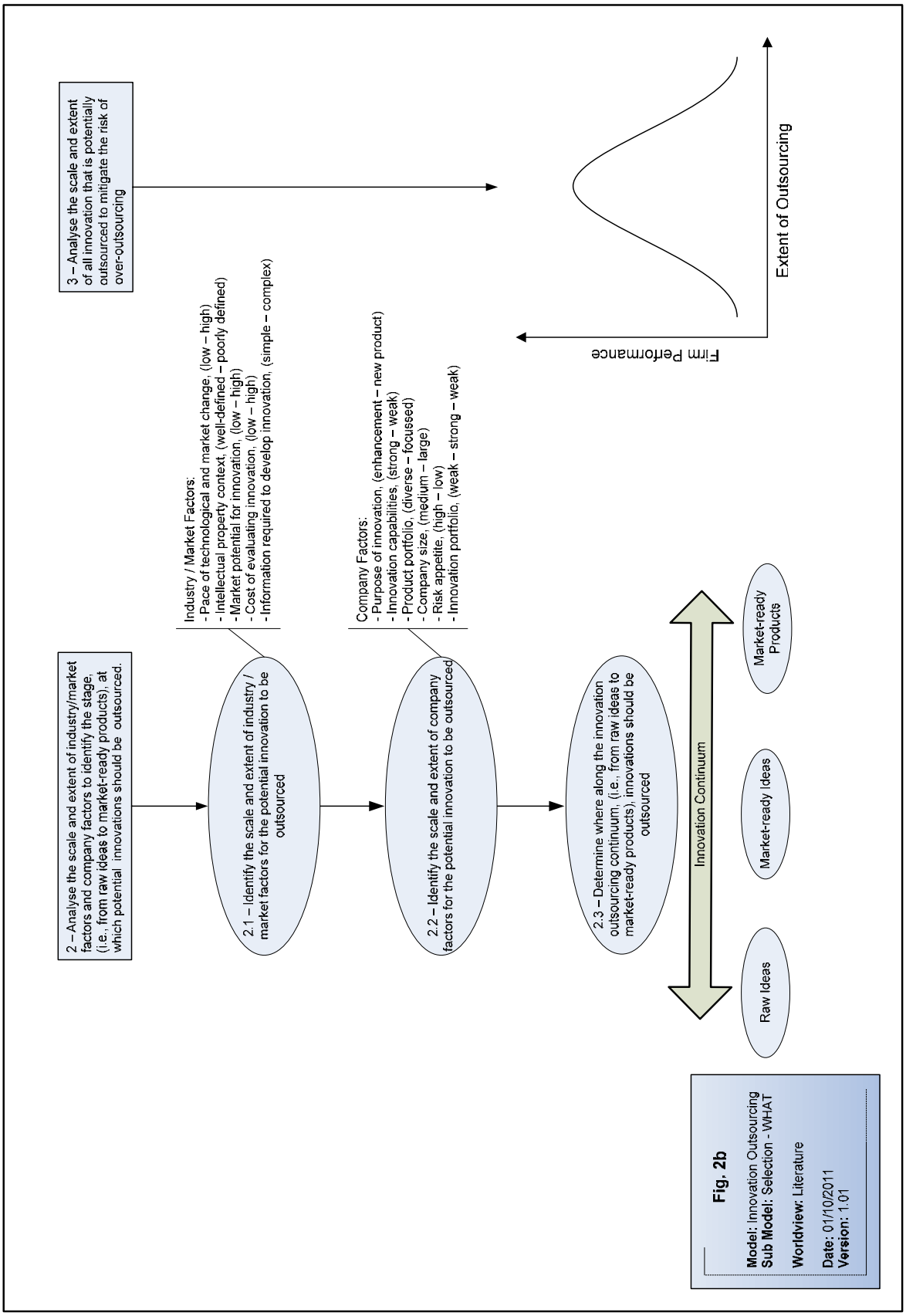
Key Questions:

Please review Figures 2a and 2b. Consider:

- What does your firm do to protect its competencies?
- How does your firm determine the stage at which potential innovations should be outsourced?
- Does your firm track the extent of innovation it outsources?

Comments:


1 – Analyse the firms innovation ecosystem to mitigate the strategic risks associated with the hollowing out of core competencies
1.1 - Define the existing knowledge boundary of the firm
1.2 – Undertake competency importance analysis
1.3 – Undertake relative capability analysis
1.4 – Identify the firms strategic sourcing options
Innovation sourcing options matrix
Relative capability position
Less capable
More capable
Significance of competency
Core competency
Non-core competency
High
Low
Low
High
Invest to perform internally or Outsource
Perform internally and develop
Outsource
Outsource or Retain internally
Fig. 2a
Model: Innovation Outsourcing
Sub Model: Selection - WHAT
Worldview: Literature
Date: 01/10/2011
Version: 1.01


2 – Analyse the scale and extent of industry/market factors and company factors to identify the stage, (i.e., from raw ideas to market-ready products), at which potential innovations should be outsourced.
2.1 – Identify the scale and extent of industry / market factors for the potential innovation to be outsourced
Industry / Market Factors:
- Pace of technological and market change, (low – high)
- Intellectual property context, (well-defined – poorly defined)
- Market potential for innovation, (low – high)
- Cost of evaluating innovation, (low – high)
- Information required to develop innovation, (simple – complex)
2.2 – Identify the scale and extent of company factors for the potential innovation to be outsourced
Company Factors:
- Purpose of innovation, (enhancement – new product)
- Innovation capabilities, (strong – weak)
- Product portfolio, (diverse – focussed)
- Company size, (medium – large)
- Risk appetite, (high – low)
- Innovation portfolio, (weak – strong – weak)
2.3 – Determine where along the innovation outsourcing continuum, (i.e., from raw ideas to market-ready products), innovations should be outsourced
Innovation Continuum
Raw Ideas
Market-ready Ideas
Market-ready Products
3 – Analyse the scale and extent of all innovation that is potentially outsourced to mitigate the risk of over-outsourcing
Firm Performance
Extent of Outsourcing
Fig. 2b
Model: Innovation Outsourcing
Sub Model: Selection - WHAT
Worldview: Literature
Date: 01/10/2011
Version: 1.01

3.4 - Selection – WHY it *should be* Outsourced

Description:

Fig. 3 represents the process by which a firm determines the key success criteria by which specific outsourced innovation activity is to be measured.

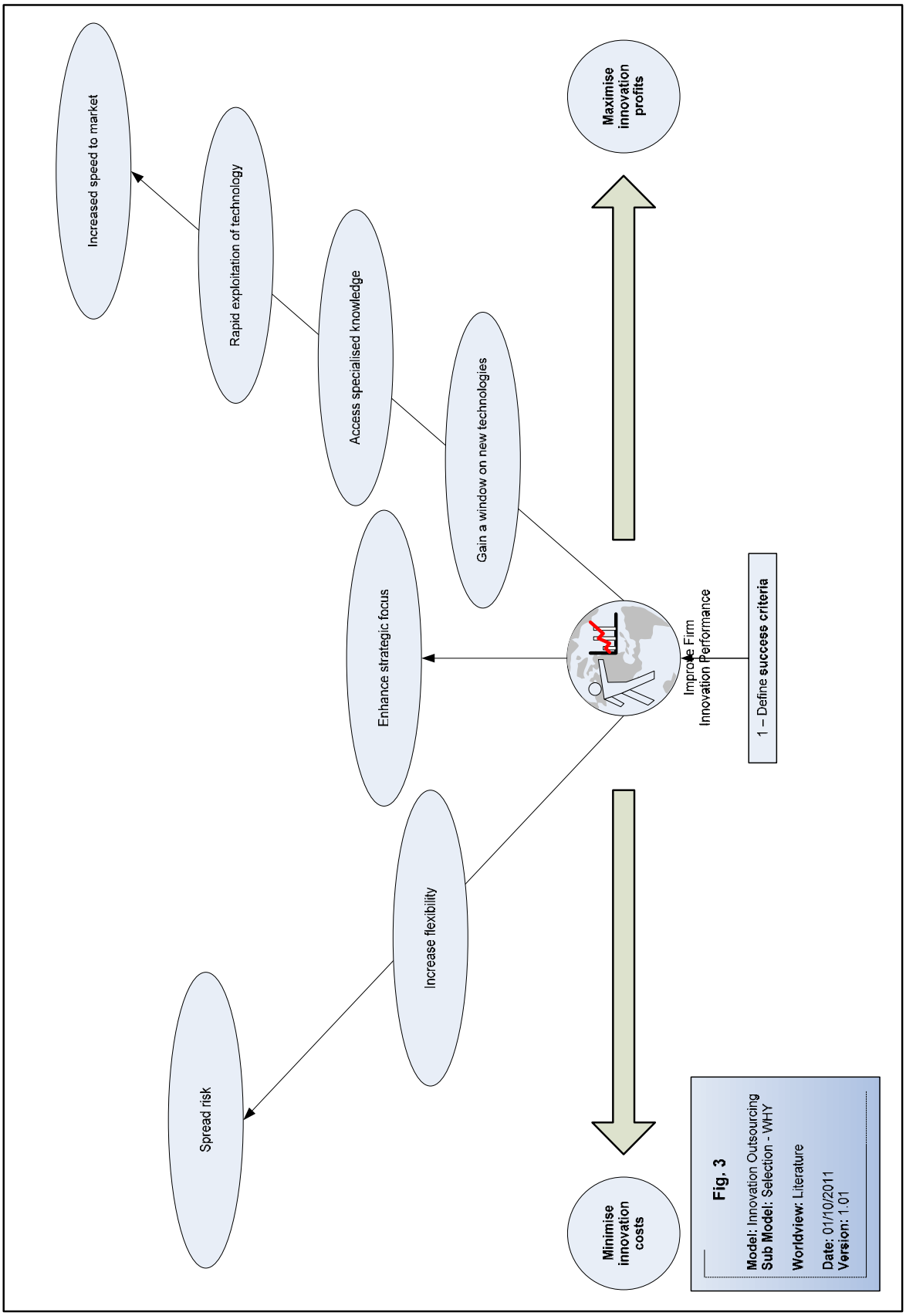
The process involves determining whether the primary aim of outsourcing the specific innovation activity is to maximise innovation profits or minimise innovation costs.

Key Questions:

Please review Fig. 3 and consider:

- How does your firm determine the success criteria and performance measures for outsourced innovation?

Comments:


Increased speed to market
Rapid exploitation of technology
Access specialised knowledge
Gain a window on new technologies
Maximise innovation profits
Enhance strategic focus
Improve Firm Innovation Performance
1 – Define success criteria
Increase flexibility
Spread risk
Minimise innovation costs
Fig. 3
Model: Innovation Outsourcing
Sub Model: Selection - WHY
Worldview: Literature
Date: 01/10/2011
Version: 1.01

3.5 - Select/Implement – WHAT is *to be* Outsourced

Description:

Fig. 4 represents the process by which a firm determines what innovation activity it can successfully outsource. It does so by identifying the organisational changes necessary for the firm to successfully outsource innovation and making the associated investment decisions.

The process involves the firm:

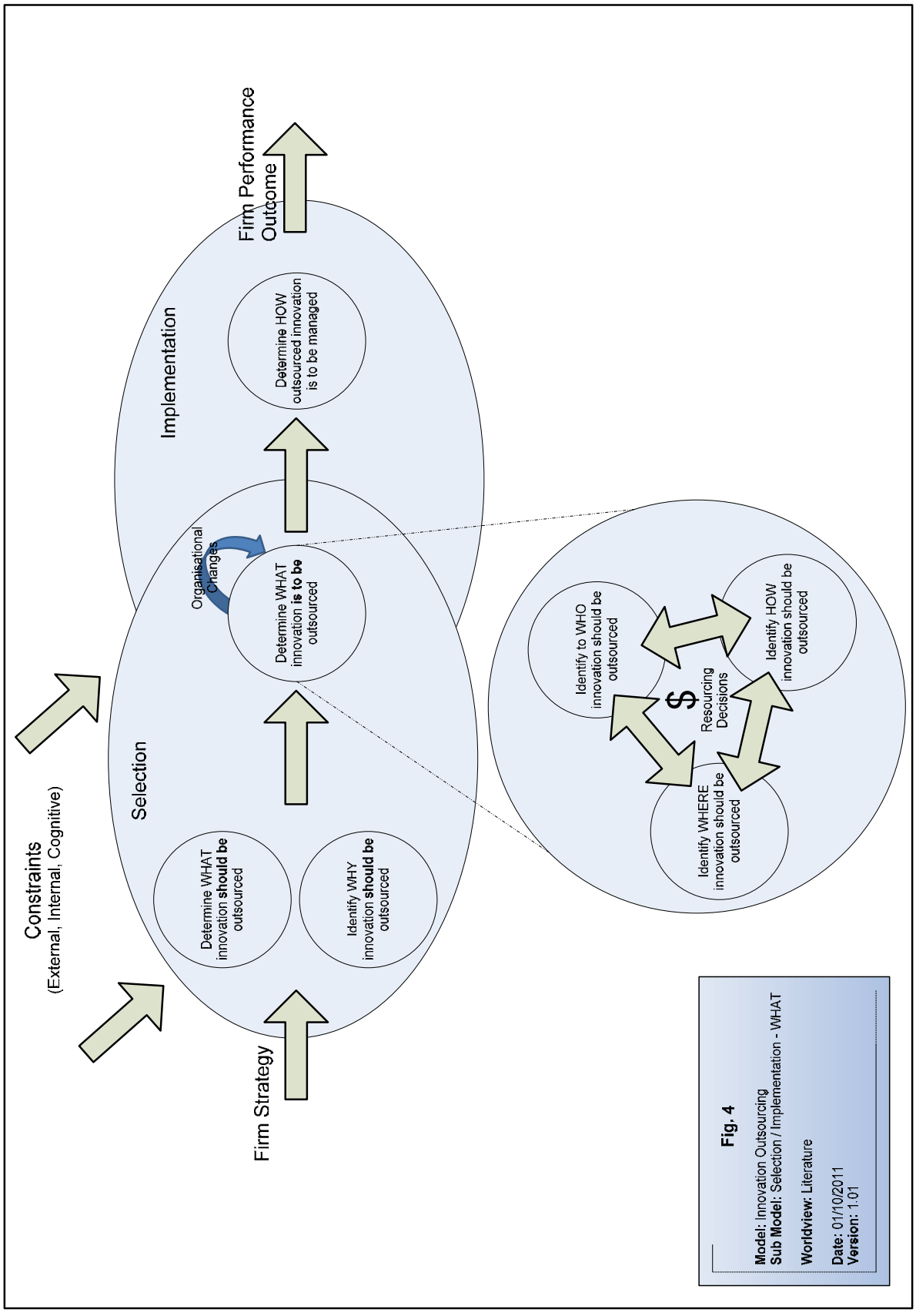
- Identifying the required capabilities for outsourcing innovation in terms of where innovation is to be outsourced, to whom and how it is to be outsourced.
- Assessing the gap between the firm's existing capabilities and required capabilities for outsourcing innovation.
- Making the investment decisions to bridge any innovation outsourcing capabilities gap.
- Implementing the decisions to develop the necessary innovation outsourcing capabilities.

Key Questions:

Please review Fig. 4 and consider:

- Does your firm identify the organisational changes necessary to successfully outsource innovation?

Comments:


Constraints
(External, Internal, Cognitive)
Firm Strategy
Selection
Determine WHAT innovation should be outsourced
Identify WHY innovation should be outsourced
Organisational Changes
Determine WHAT innovation is to be outsourced
Implementation
Determine HOW outsourced innovation is to be managed
Firm Performance Outcome
Identify to WHO innovation should be outsourced
Identify HOW innovation should be outsourced
Resourcing Decisions
Identify WHERE innovation should be outsourced
Fig. 4
Model: Innovation Outsourcing
Sub Model: Selection / Implementation - WHAT
Worldview: Literature
Date: 01/10/2011
Version: 1.01

3.6 - Select/Implement – WHERE it should be Outsourced

Description:

Fig. 5 represents the considerations of firms in determining where innovation should be outsourced, whether it is onshore or offshore.

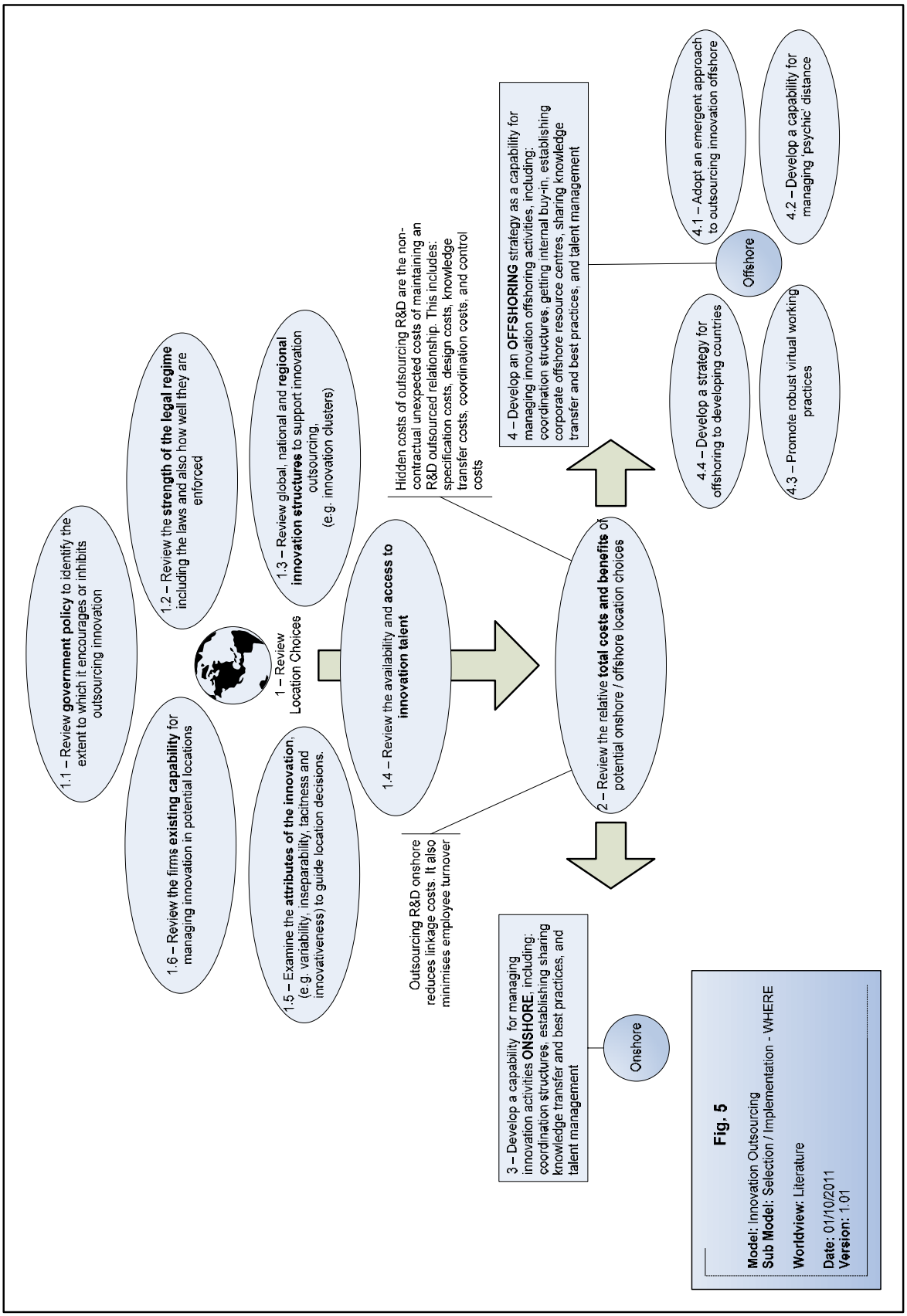
The considerations include: government policy for supporting innovation outsourcing; the strength of legal regimes; the strength of regional innovation structures; the availability and access to innovation talent; examining how well the characteristics of the innovation activity lend themselves to potential location choices, and; reviewing existing capability for managing in potential locations.

Key Questions:

Please review Fig. 5 and consider:

- How does your firm determine the best location for outsourcing innovation?

Comments:


1.1 – Review government policy to identify the extent to which it encourages or inhibits outsourcing innovation
1.2 – Review the strength of the legal regime including the laws and also how well they are enforced
1.3 – Review global, national and regional innovation structures to support innovation outsourcing. (e.g. innovation clusters)
1.6 – Review the firms existing capability for managing innovation in potential locations
1 – Review Location Choices
1.5 – Examine the attributes of the innovation, (e.g. variability, inseparability, tacitness and innovativeness) to guide location decisions.
1.4 – Review the availability and access to innovation talent
Hidden costs of outsourcing R&D are the non-contractual unexpected costs of maintaining an R&D outsourced relationship. This includes: specification costs, design costs, knowledge transfer costs, coordination costs, and control costs
Outsourcing R&D onshore reduces linkage costs. It also minimises employee turnover
2 – Review the relative total costs and benefits of potential onshore / offshore location choices
4 – Develop an OFFSHORING strategy as a capability for managing innovation offshoring activities, including: coordination structures, getting internal buy-in, establishing corporate offshore resource centres, sharing knowledge transfer and best practices, and talent management
3 – Develop a capability for managing innovation activities ONSHORE, including: coordination structures, establishing sharing knowledge transfer and best practices, and talent management
Onshore
Offshore
4.1 – Adopt an emergent approach to outsourcing innovation offshore
4.2 – Develop a capability for managing 'psychic' distance
4.4 – Develop a strategy for offshoring to developing countries
4.3 – Promote robust virtual working practices
Fig. 5
Model: Innovation Outsourcing
Sub Model: Selection / Implementation - WHERE
Worldview: Literature
Date: 01/10/2011
Version: 1.01

3.7 - Select/Implement – to WHO should it be Outsourced

Description:

Fig. 6 represents the process by which firms determine to whom innovation should be outsourced.

The process involves:

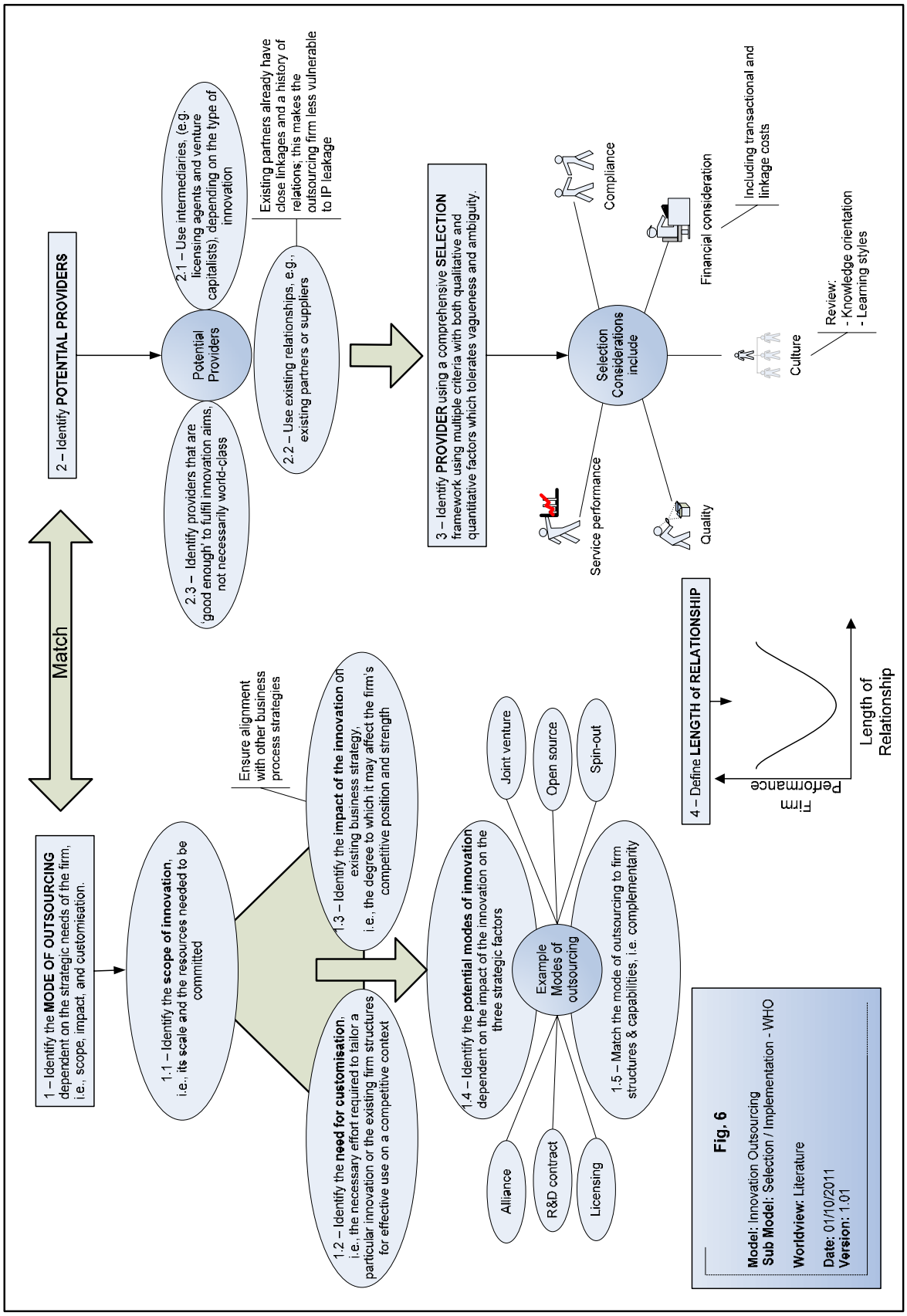
- Identifying, from the strategic needs of the firm, the appropriate mode of outsourcing for the innovation activity to be outsourced.
- Identifying potential providers/partners.
- Providing due consideration to multiple criteria when selecting appropriate providers.
- Identifying the appropriate length of an outsourced innovation relationship.

Key Questions:

Please review Fig. 6 and consider:

- How does your firm determine the mode of outsourcing for outsourced innovation?
- What process does your firm use for selecting providers / partners when outsourcing innovation?
- How does your firm determine the appropriate length of an outsourcing relationship?

Comments:


1 – Identify the MODE OF OUTSOURCING dependent on the strategic needs of the firm, i.e., scope, impact, and customisation.
Match
1.1 – Identify the scope of innovation, i.e., its scale and the resources needed to be committed
Ensure alignment with other business process strategies
1.3 – Identify the impact of the innovation on existing business strategy, i.e., the degree to which it may affect the firm's competitive position and strength
1.2 – Identify the need for customisation, i.e. the necessary effort required to tailor a particular innovation or the existing firm structures for effective use on a competitive context
1.4 – Identify the potential modes of innovation dependent on the impact of the innovation on the three strategic factors
Example Modes of outsourcing
Joint venture
Open source
Spin-out
Alliance
R&D contract
Licensing
1.5 – Match the mode of outsourcing to firm structures & capabilities, i.e. complementarity
2 – Identify POTENTIAL PROVIDERS
Potential Providers
2.1 – Use intermediaries, (e.g. licensing agents and venture capitalists), depending on the type of innovation
2.2 – Use existing relationships, e.g., existing partners or suppliers
Existing partners already have close linkages and a history of relations; this makes the outsourcing firm less vulnerable to IP leakage
2.3 – Identify providers that are 'good enough' to fulfil innovation aims, not necessarily world-class
3 – Identify PROVIDER using a comprehensive SELECTION framework using multiple criteria with both qualitative and quantitative factors which tolerates vagueness and ambiguity.
Selection Considerations include
Compliance
Financial consideration
Including transactional and linkage costs
Culture
Review:
- Knowledge orientation
- Learning styles
Service performance
Quality
4 – Define LENGTH of RELATIONSHIP
Firm Performance
Length of Relationship
Fig. 6
Model: Innovation Outsourcing
Sub Model: Selection / Implementation - WHO
Worldview: Literature
Date: 01/10/2011
Version: 1.01

3.8 - Select/Implement – HOW it should be Outsourced

Description:

Figures 7a, 7b and 7c represent the considerations of firms in determining how innovation should be outsourced.

Fig. 7a represents the considerations for firm flexibility to aid better spanning of firm boundaries, learning and exploitation of new knowledge.

Fig. 7b represents the considerations by firms for effective governance and control, (both formal and informal), of partners and providers, i.e., safeguarding intellectual property without inhibiting innovative activity.

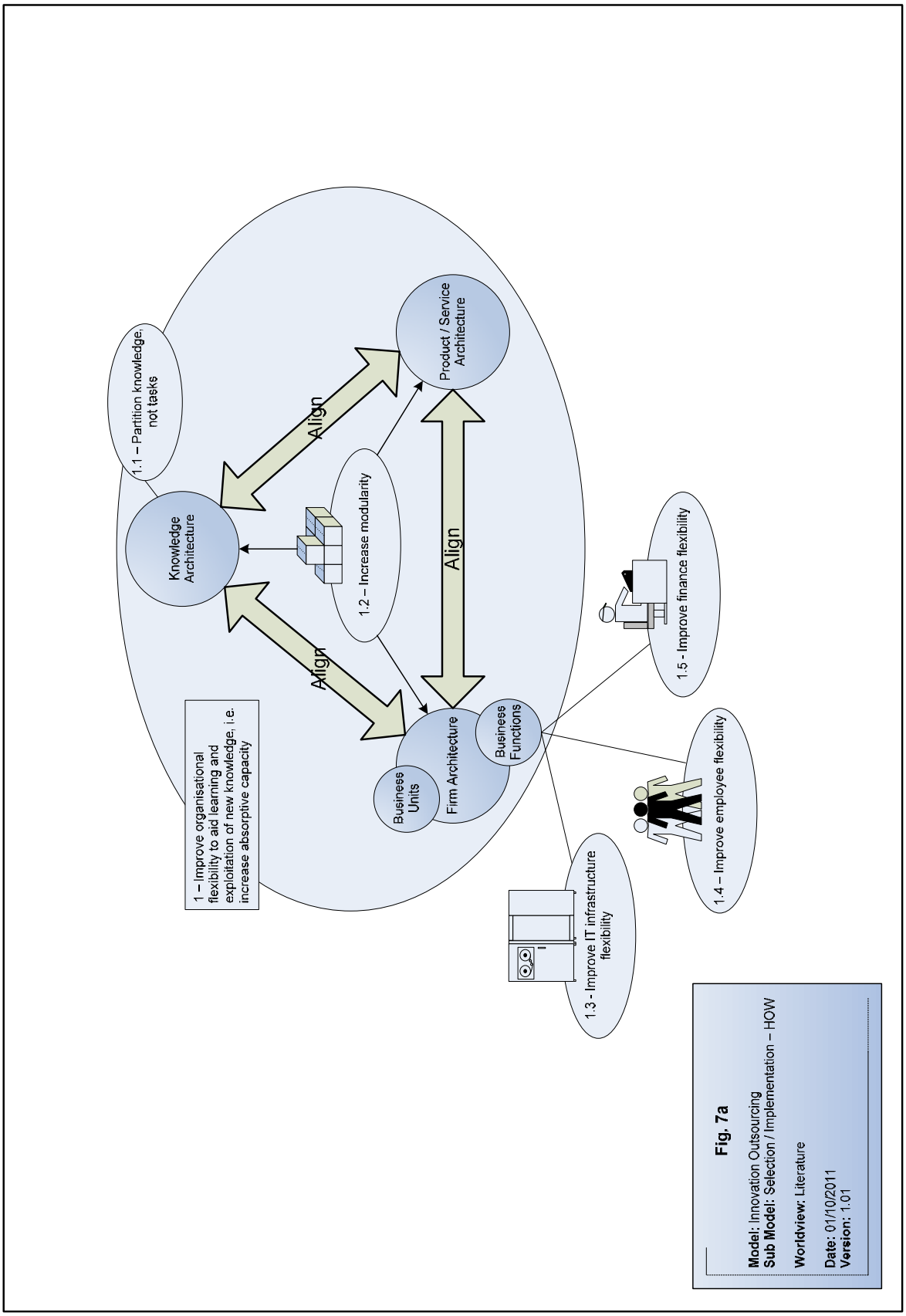
Fig. 7c represents the considerations by firms for developing a culture that supports innovation outsourcing.

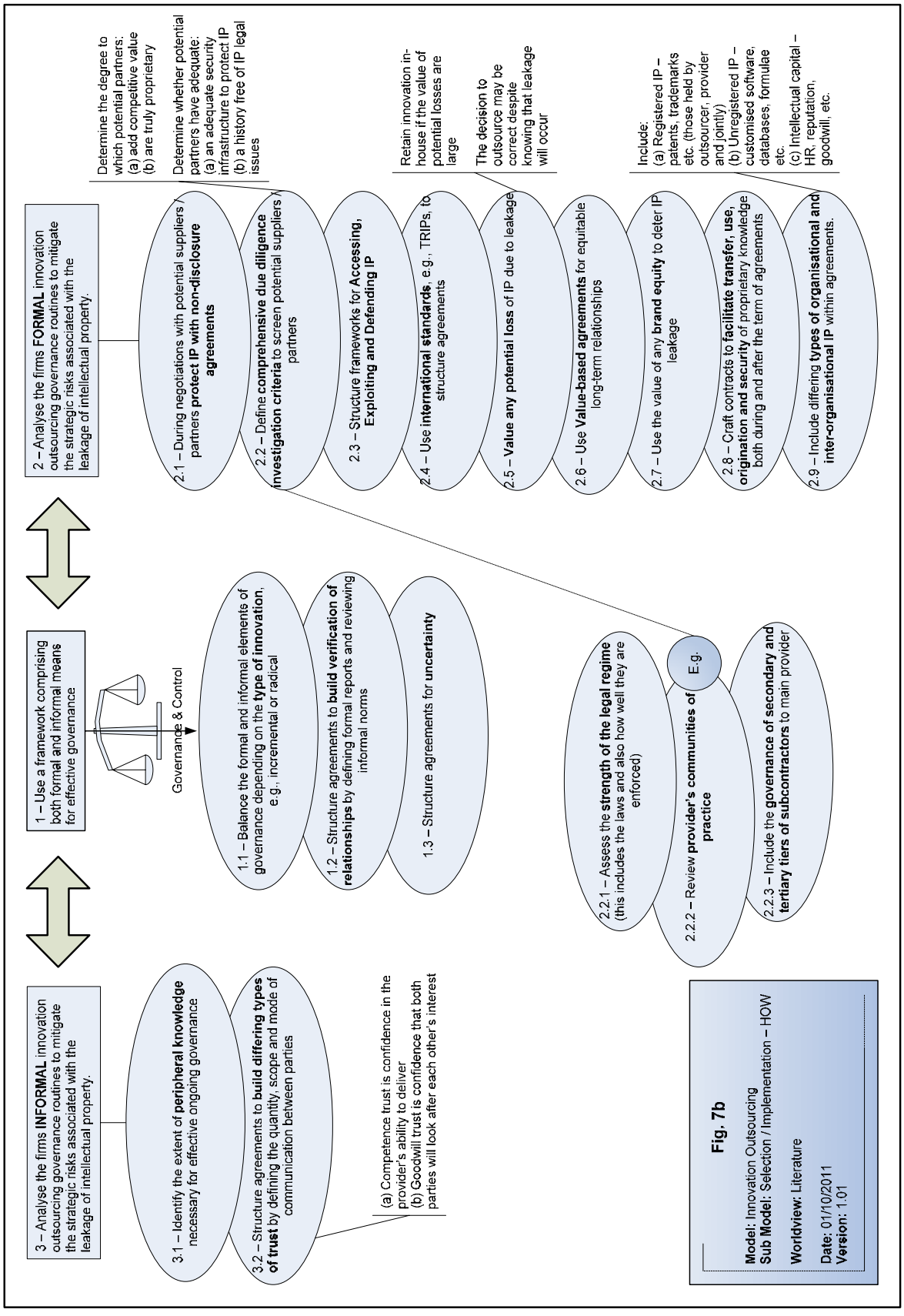
Key Questions:

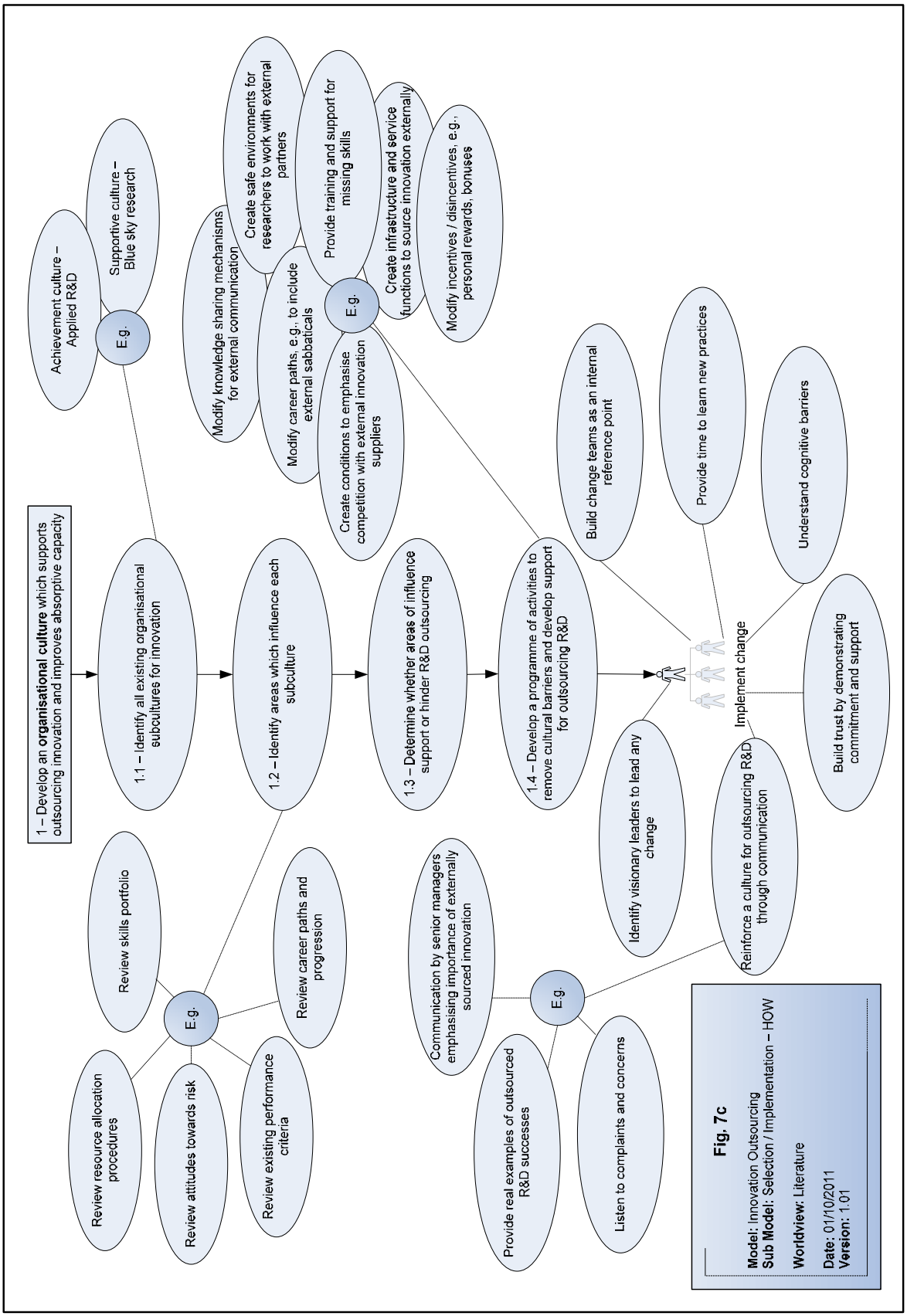
Please review Figures 7a, 7b and 7c, and consider:

- What changes to firm structures does your firm review when outsourcing innovation?
- How do your firm's governance and control processes for outsourced innovation differ from those for in-house innovation?
- How does your firm develop a culture for outsourcing innovation?

Comments:


1.1 – Partition knowledge, not tasks
Knowledge Architecture
Product / Service Architecture
Align
Align
Align
1.2 – Increase modularity
Business Units
Firm Architecture
Business Functions
1 – Improve organisational flexibility to aid learning and exploitation of new knowledge, i.e. increase absorptive capacity
1.3 - Improve IT infrastructure flexibility
1.4 – Improve employee flexibility
1.5 - Improve finance flexibility
Fig. 7a
Model: Innovation Outsourcing
Sub Model: Selection / Implementation – HOW
Worldview: Literature
Date: 01/10/2011
Version: 1.01


3 – Analyse the firms INFORMAL innovation outsourcing governance routines to mitigate the strategic risks associated with the leakage of intellectual property.
3.1 – Identify the extent of peripheral knowledge necessary for effective ongoing governance
3.2 – Structure agreements to build differing types of trust by defining the quantity, scope and mode of communication between parties
(a) Competence trust is confidence in the provider's ability to deliver
(b) Goodwill trust is confidence that both parties will look after each other's interest
1 – Use a framework comprising both formal and informal means for effective governance
Governance & Control
1.1 – Balance the formal and informal elements of governance depending on the type of innovation, e.g., incremental or radical
1.2 – Structure agreements to build verification of relationships by defining formal reports and reviewing informal norms
1.3 – Structure agreements for uncertainty
2 – Analyse the firms FORMAL innovation outsourcing governance routines to mitigate the strategic risks associated with the leakage of intellectual property.
2.1 – During negotiations with potential suppliers / partners protect IP with non-disclosure agreements
Determine the degree to which potential partners: (a) add competitive value (b) are truly proprietary
Determine whether potential partners have adequate: (a) an adequate security infrastructure to protect IP (b) a history free of IP legal issues
2.2 – Define comprehensive due diligence investigation criteria to screen potential suppliers / partners
2.3 – Structure frameworks for Accessing, Exploiting and Defending IP
2.4 – Use international standards, e.g., TRIPs, to structure agreements
Retain innovation in-house if the value of potential losses are large
2.5 – Value any potential loss of IP due to leakage
The decision to outsource may be correct despite knowing that leakage will occur
2.6 – Use Value-based agreements for equitable long-term relationships
2.7 – Use the value of any brand equity to deter IP leakage
2.8 – Craft contracts to facilitate transfer, use, origination and security of proprietary knowledge both during and after the term of agreements
Include: (a) Registered IP – patents, trademarks etc. (those held by outsourcer, provider and jointly) (b) Unregistered IP – customised software, databases, formulae etc. (c) Intellectual capital – HR, reputation, goodwill, etc.
2.9 – Include differing types of organisational and inter-organisational IP within agreements.
2.2.1 – Assess the strength of the legal regime (this includes the laws and also how well they are enforced)
2.2.2 – Review provider's communities of practice
E.g.
2.2.3 – Include the governance of secondary and tertiary tiers of subcontractors to main provider
Fig. 7b
Model: Innovation Outsourcing
Sub Model: Selection / Implementation – HOW
Worldview: Literature
Date: 01/10/2011
Version: 1.01


1 – Develop an **organisational culture** which supports outsourcing innovation and improves absorptive capacity
1.1 – Identify all existing organisational subcultures for innovation
1.2 – Identify areas which influence each subculture
1.3 – Determine whether areas of influence support or hinder R&D outsourcing
1.4 – Develop a programme of activities to remove cultural barriers and develop support for outsourcing R&D
E.g.
Achievement culture – Applied R&D
Supportive culture – Blue sky research
E.g.
Review resource allocation procedures
Review attitudes towards risk
Review existing performance criteria
Review skills portfolio
Review career paths and progression
E.g.
Modify knowledge sharing mechanisms for external communication
Create safe environments for researchers to work with external partners
Modify career paths, e.g., to include external sabbaticals
Provide training and support for missing skills
Create conditions to emphasise competition with external innovation suppliers
Create infrastructure and service functions to source innovation externally
Modify incentives / disincentives, e.g., personal rewards, bonuses
E.g.
Communication by senior managers emphasising importance of externally sourced innovation
Provide real examples of outsourced R&D successes
Listen to complaints and concerns
Identify visionary leaders to lead any change
Reinforce a culture for outsourcing R&D through communication
Build change teams as an internal reference point
Provide time to learn new practices
Understand cognitive barriers
Build trust by demonstrating commitment and support
Implement change
Fig. 7c
Model: Innovation Outsourcing
Sub Model: Selection / Implementation – HOW
Worldview: Literature
Date: 01/10/2011
Version: 1.01

3.9 - Implementation – HOW is it Managed

Description:

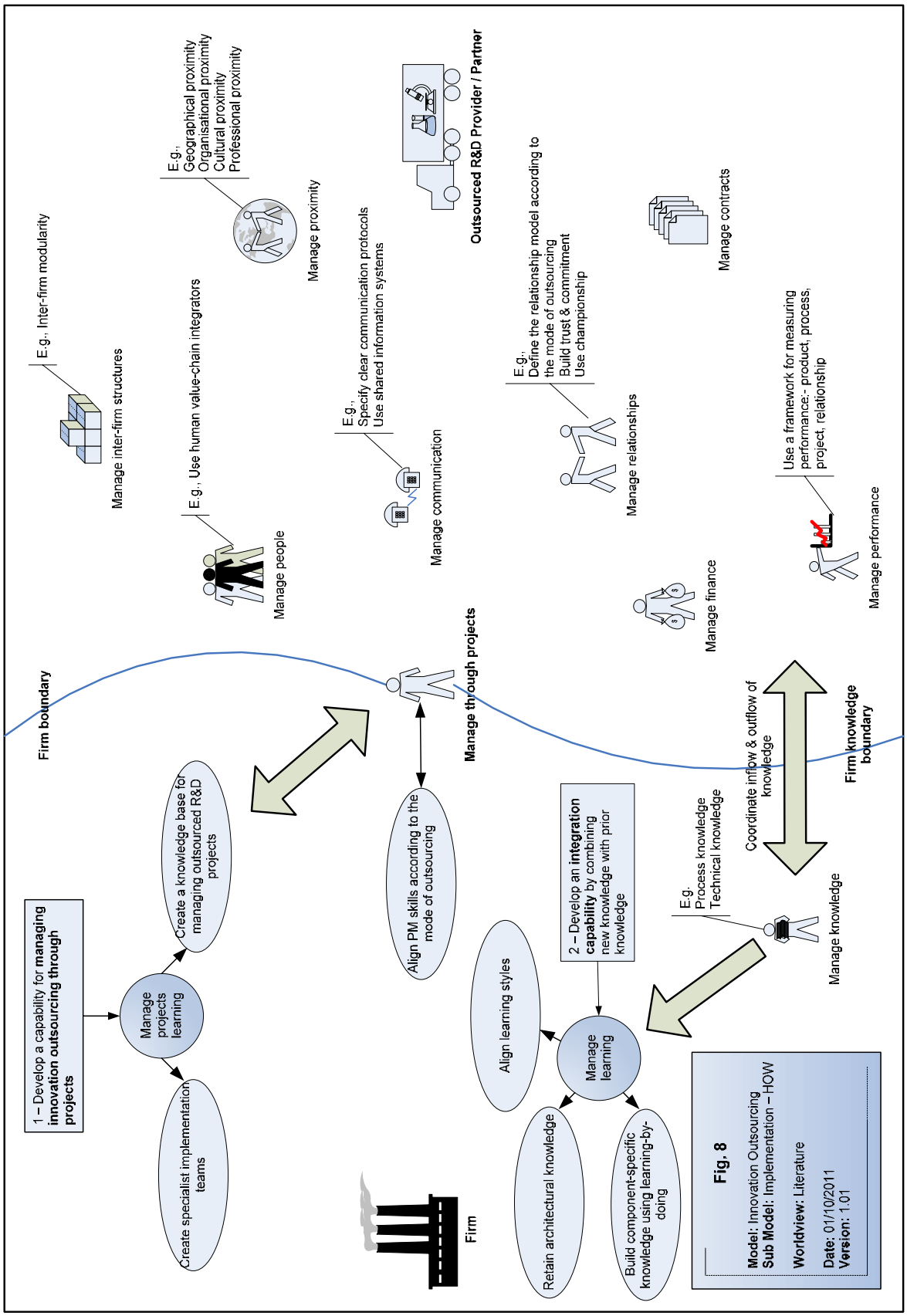
Fig. 8 represents the considerations for firms when developing a capability for routinely managing innovation outsourcing through projects.

Key Questions:

Please review Fig. 8 and consider:

- How does your firm manage outsourced innovation day-to-day?

Comments:


1 – Develop a capability for managing innovation outsourcing through projects
Manage projects learning
Create a knowledge base for managing outsourced R&D projects
Create specialist implementation teams
Firm boundary
Manage through projects
Align PM skills according to the mode of outsourcing
Firm
Align learning styles
Manage learning
2 – Develop an integration capability by combining new knowledge with prior knowledge
Retain architectural knowledge
Build component-specific knowledge using learning-by-doing
E.g.
Process knowledge
Technical knowledge
Manage knowledge
Coordinate inflow & outflow of knowledge
Firm knowledge boundary
E.g., Inter-firm modularity
Manage inter-firm structures
E.g., Use human value-chain integrators
Manage people
E.g.,
Geographical proximity
Organisational proximity
Cultural proximity
Professional proximity
Manage proximity
E.g.,
Specify clear communication protocols
Use shared information systems
Manage communication
Outsourced R&D Provider / Partner
E.g.,
Define the relationship model according to the mode of outsourcing
Build trust & commitment
Use championship
Manage relationships
Manage contracts
Manage finance
Use a framework for measuring performance:- product, process, project, relationship
Manage performance
Fig. 8
Model: Innovation Outsourcing
Sub Model: Implementation – HOW
Worldview: Literature
Date: 01/10/2011
Version: 1.01